

Test Tutorial

Equipment Type: Protection Relay

Brand: Schweitzer (SEL)

Model: 751A

Function: 50 or PIOC- Instantaneous Overcurrent and 51 or PTOC – Time Overcurrent

Tool Used: CE- 6003; CE-6006; CE6707; CE-6710; CE-7012 or CE-7024

Objective: Timed pickup test of the units of Phase (51), timed curve survey, instantaneous pickup test of phase units (50).

Version control:

Version	Descriptions	Date	Author	Reviewer
1.0	Initial Version	12/08/2021	M.R.C.	M.P.S

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Statement of responsibility

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Suggestions for improvement of this material are welcome, just user contacts us via email suporte@conprove.com.br.

The tutorial contains knowledge gained from the resources and technical data at the time was writing. Therefore, CONPROVE reserves the right to make changes to this document without prior notice.

This document is intended as a guide only; the manual of the equipment under tested must always be consulted.



ATTENTION!

The equipment generates high current and voltage values during its operation. Improper use of the equipment can result in material and physical damage.

Only suitably qualified people must handle the instrument. It should be noted that the user must have satisfactory training in maintenance procedures, a good knowledge of the equipment under tested and also be aware of safety standards and regulations.

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Sequence for testing the SEL 751A relay in Quick software

1. Relay connection to CE-6006

Appendix A-1 shows the relay terminal designations.

1.1 Auxiliary Source

Connect the positive (red terminal) of the Vdc Aux. Source to pin A01 on the relay terminal and the negative (black terminal) of the Vdc Aux. Source to pin A02 on the relay terminal.

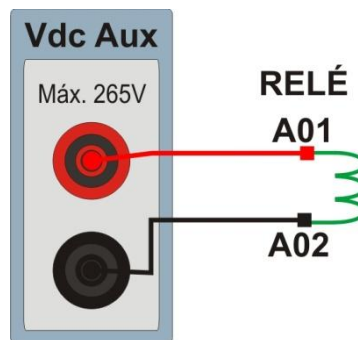


Figure 1

1.2 Current Coils

To establish the connection of the current coils, connect the I1 and I2, I3 and I4, I5 and I6 current channels to pins Z01, Z03 and Z05 of the relay terminal and connect the common of the current channels to pins Z02, Z04 and Z06 of the relay terminal. Using two channels for each current coil increases the maximum current generation limit to 40 A.

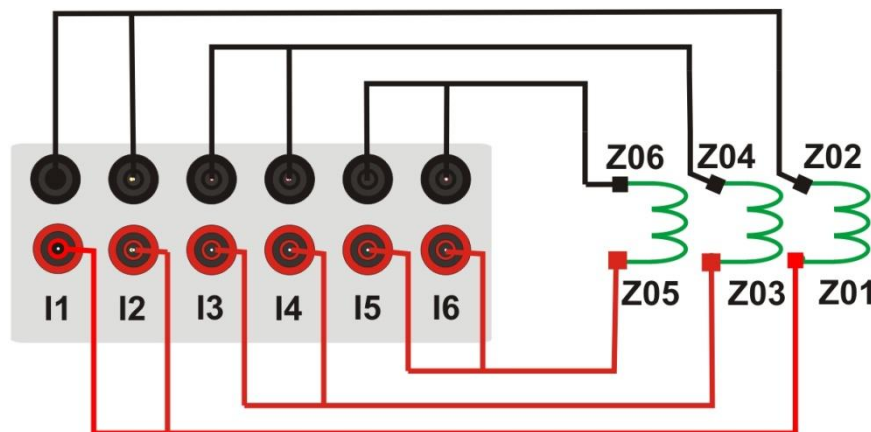


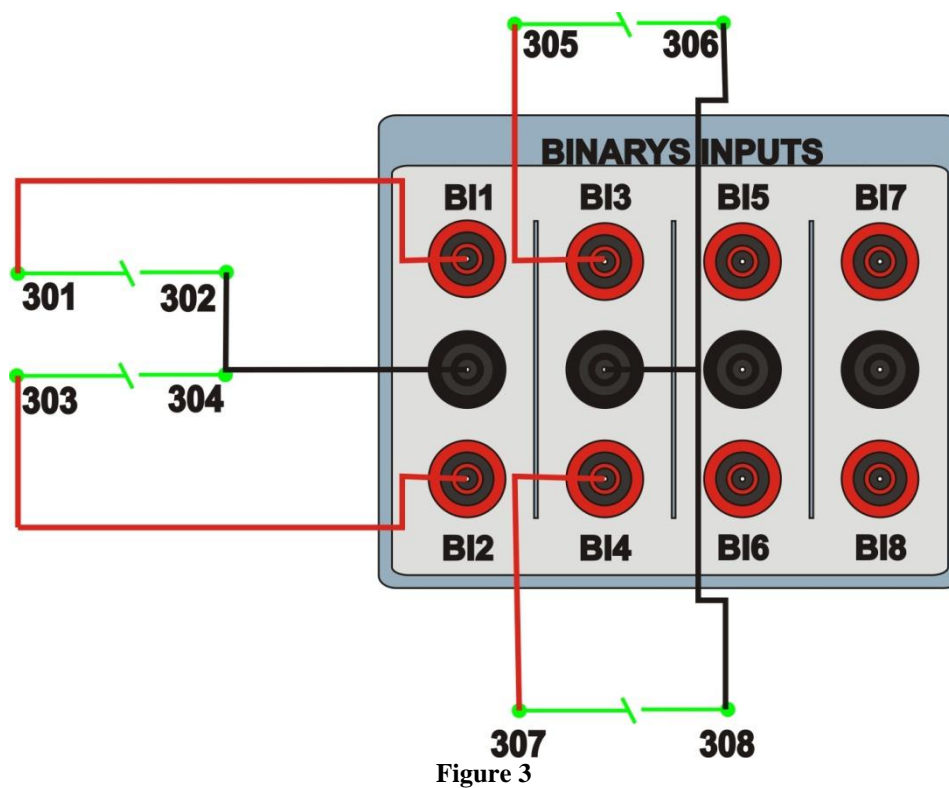
Figure 2

1.3 Binary Inputs

Connect CE-6006 binary inputs to relay binary outputs.

- BI1 to pin 301 and its common to pin 302;
- BI2 to pin 303 and its common to pin 304;
- BI3 to pin 305 and its common to pin 306;
- BI4 to pin 307 and its common to pin 308.

The following figure shows the details of these connections.



2. Communication with the SEL 751A relay

First open the “AcSELerator QuickSet” and connect an Ethernet (or serial) cable from the notebook to the relay. Then double click on the software icon.



Figure 4

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Click on the icon highlighted below to parameterize the communication settings.

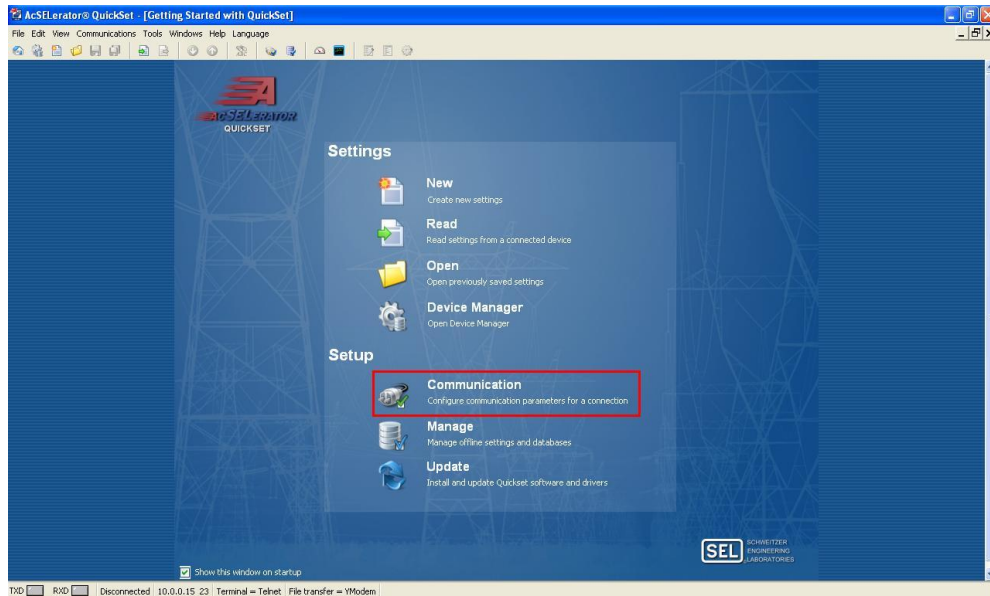


Figure 5

This relay allows three communication options: via serial cable, Ethernet cable and via modem. In this tutorial we used the communication via Ethernet, in this first case visualized on the front panel of the relay through the path “*SET / Show > Port> 1> Port 1 Settings*” the adjustment “*IPADDR*” equivalent to setting “*Host IP Address*” and the “*TPORT*” option equivalent to the “*Port Number (Telnet)*” setting.

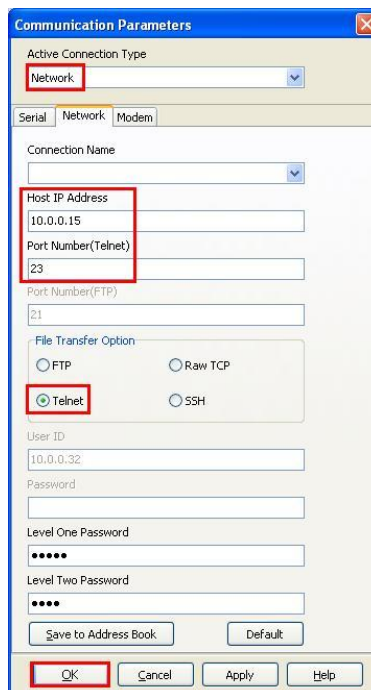


Figure 6

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To read the relay settings click on the icon highlighted below.

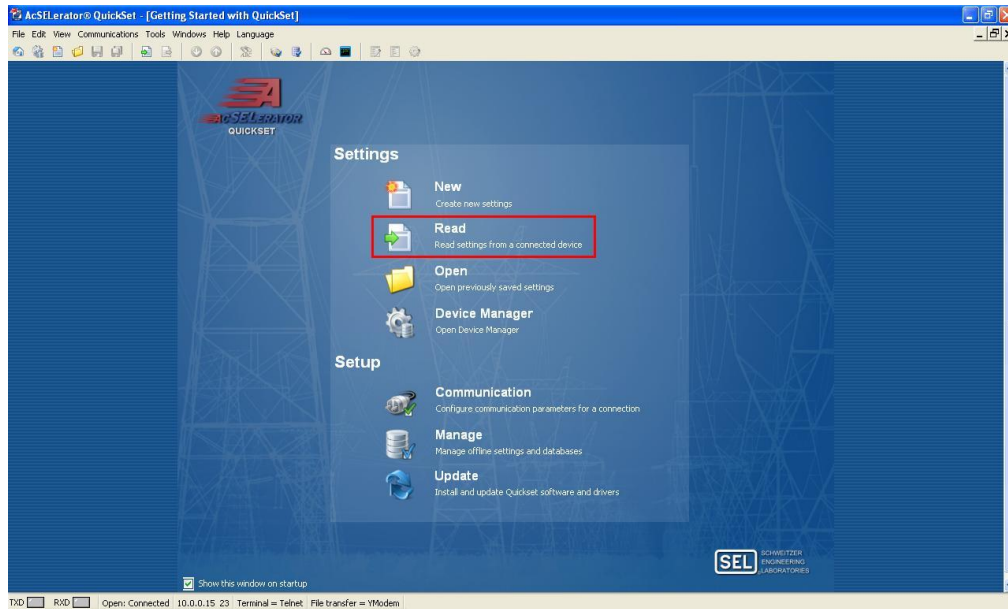


Figure 7

3. Parameterization of the SEL 751A relay

3.1 General

After reading the relay data click on the “+” sign next to “Global” and then “General”. This tab set up the nominal values of phase sequence and frequency.

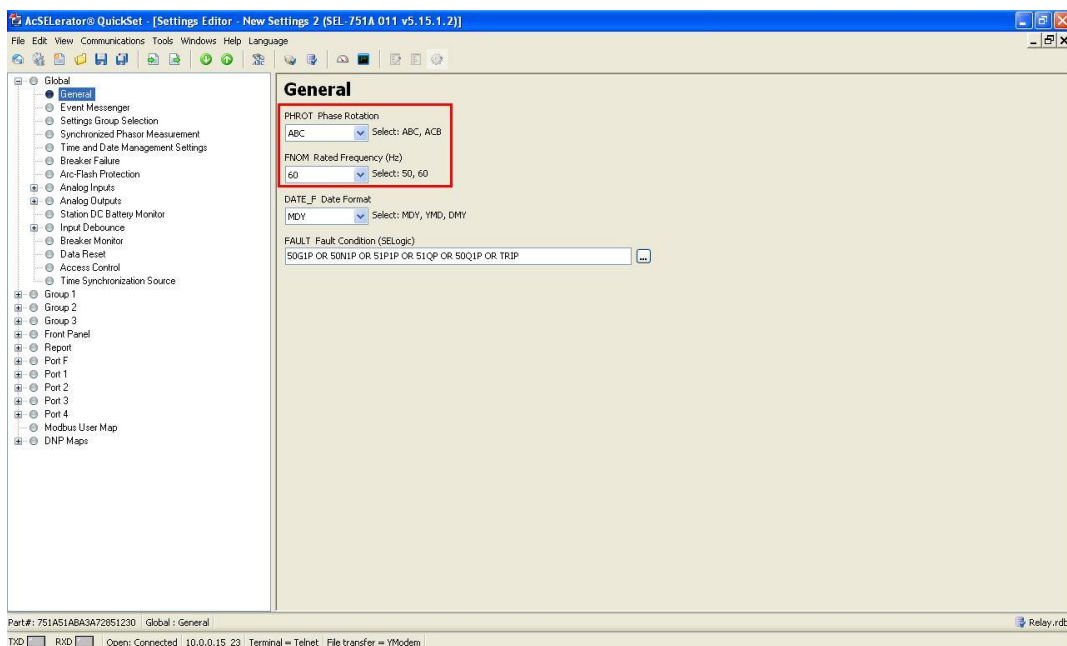


Figure 8

3.2 Main

Click on “+” signs next to “Group 1” and “Set 1” and choose the option “Main” In this window set up the values of transformation ratios both CT and VT.

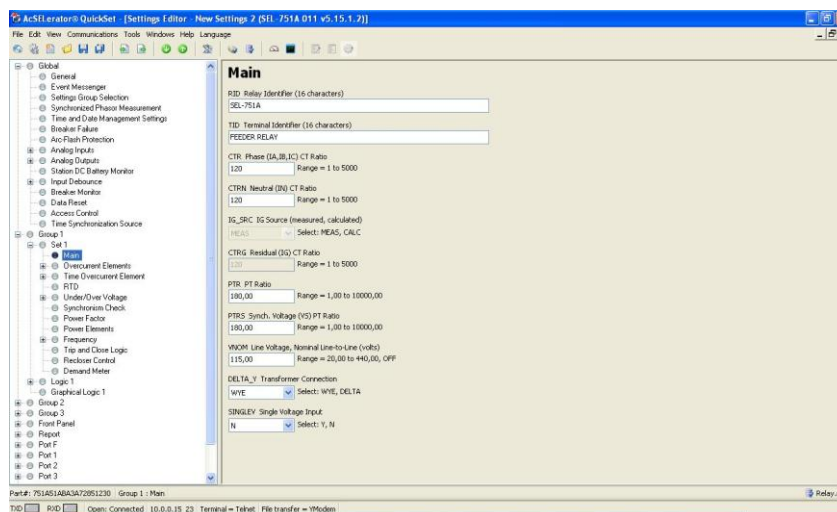


Figure 9

3.3 Phase Overcurrent

Click the “+” sign next to “Overcurrent Elements” then “Phase Overcurrent”. The relay allows you to adjust up to four elements with definite time and in these tutorial two elements are used. The pick-up value of element 1 being adjusted to 25.0A with an actuation time of 0.3s and element 2 to 37.5A with an actuation time of 0.0s.

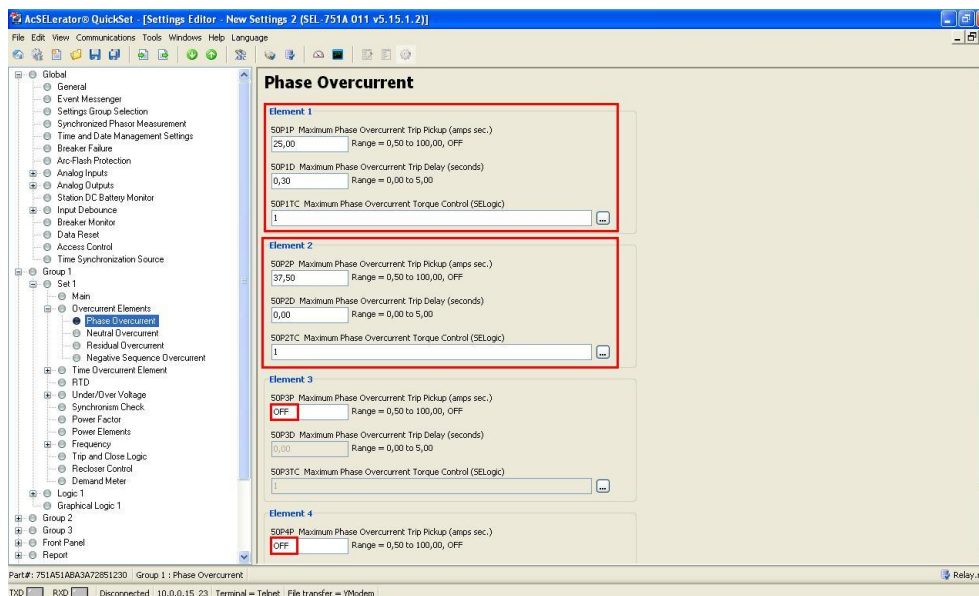


Figure 10

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3.4 Phase TOC

Click the “+” sign next to “Time Overcurrent Element” then “Phase TOC”. This option sets the timed element pickup, the time dial and the curve type. The relay allows different adjustments for each phase. For simplicity the settings of all phases are the same.

Table 1

Pickup Current	2.5
Curve Standard	IEC
Curve Type	C1 = Standard Inverse
Time dial	0.5

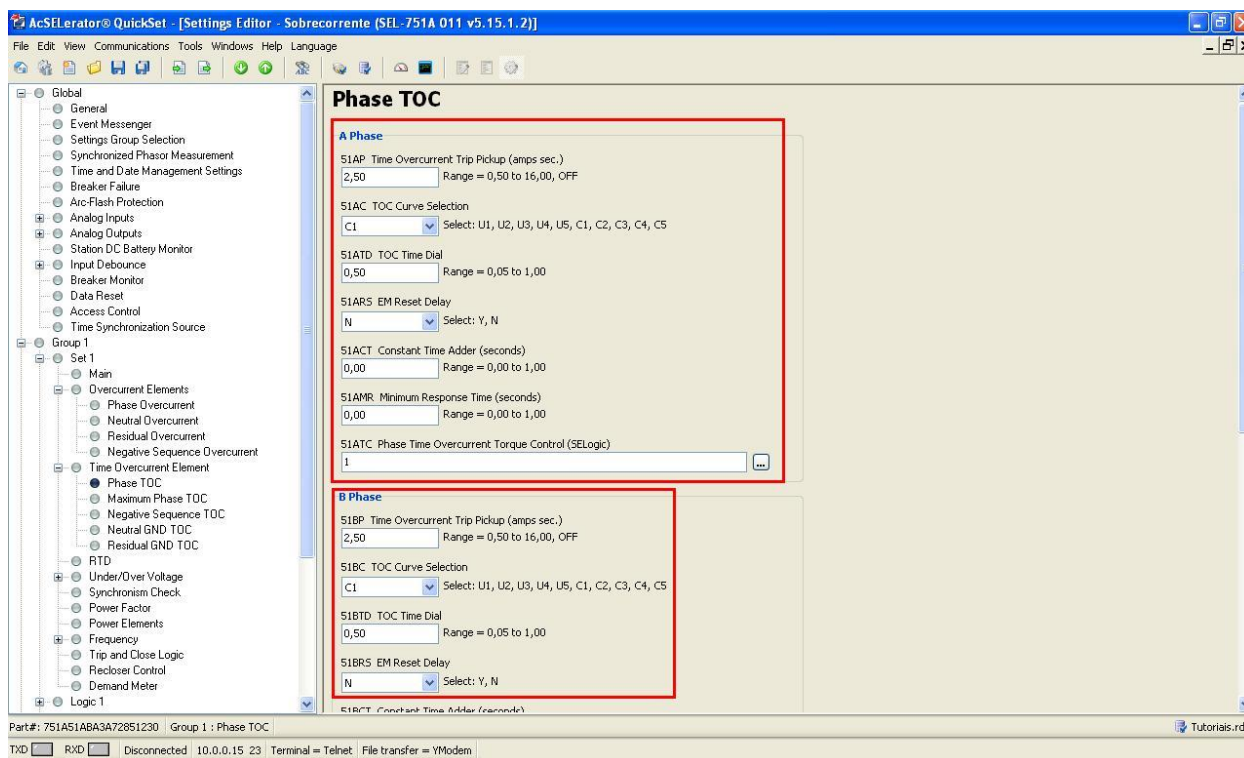


Figure 11

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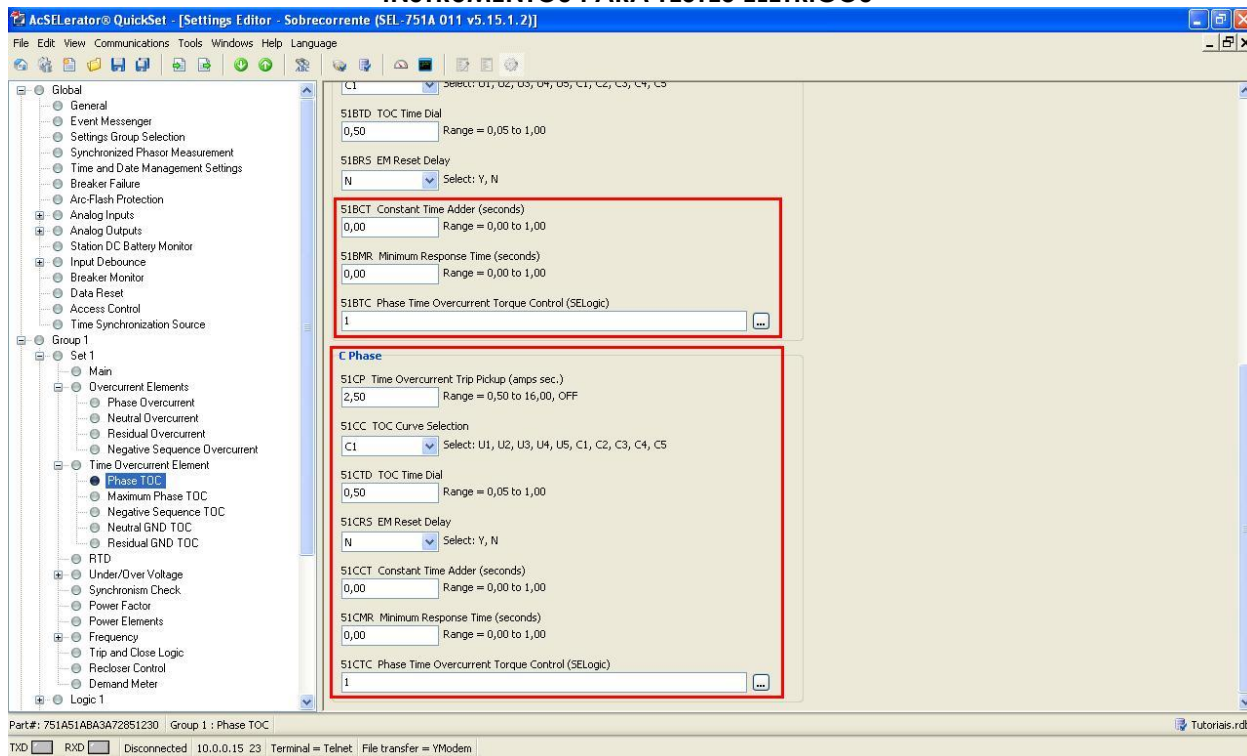


Figure 12

3.5 Slot C

By clicking on the “+” sign next to “Logic 1” and then “Slot C” you can assign function trips to each output using “Relay Word Bits”. The outputs have been linked as follows:

- OUT301 – Trip of element 50-1;
- OUT302 – Trip of element 50-2;
- OUT303 – “OR” logic between the trip signals of the 51 elements of the three phases;
- OUT304 – “OR” logic between the pick-up signals of the 51 elements of the three phases.

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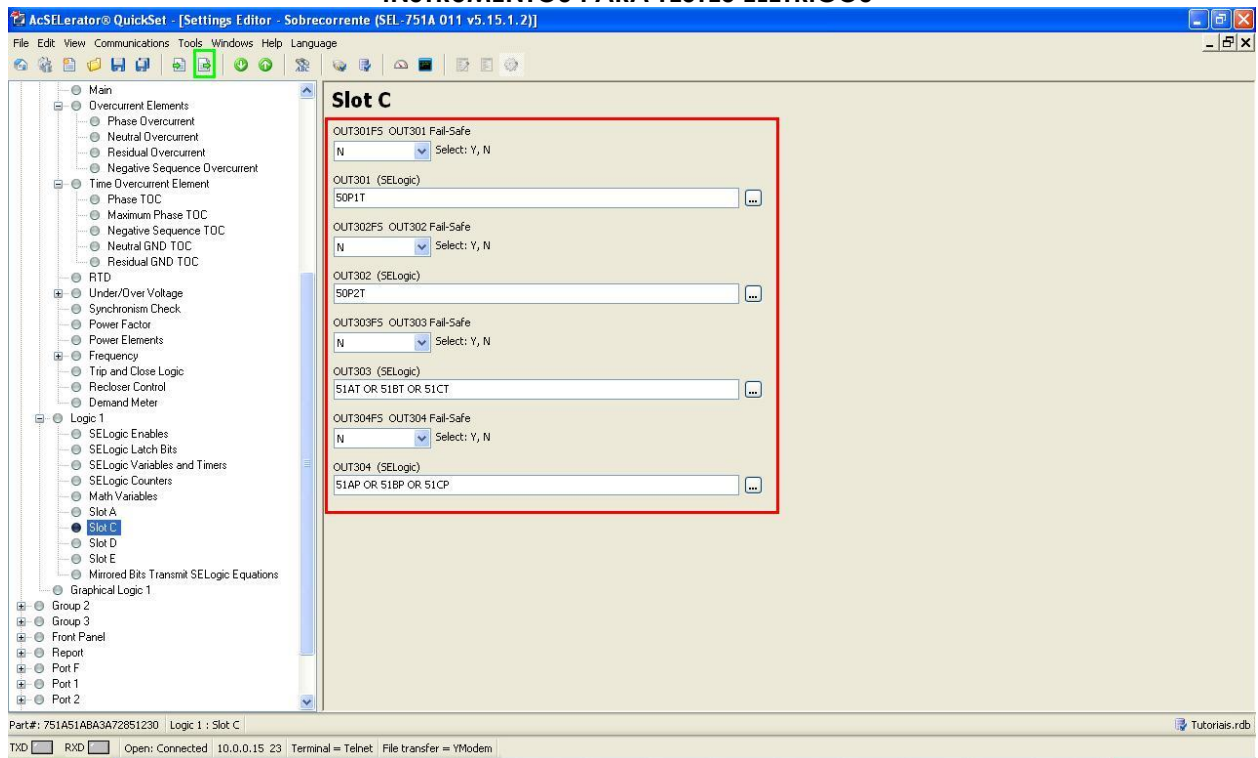


Figure 13

After making all the adjustments, click on the icon highlighted in green in the previous figure to send the modifications to the relay. The next figure shows the options that have been modified. To send the changes click on “OK”.

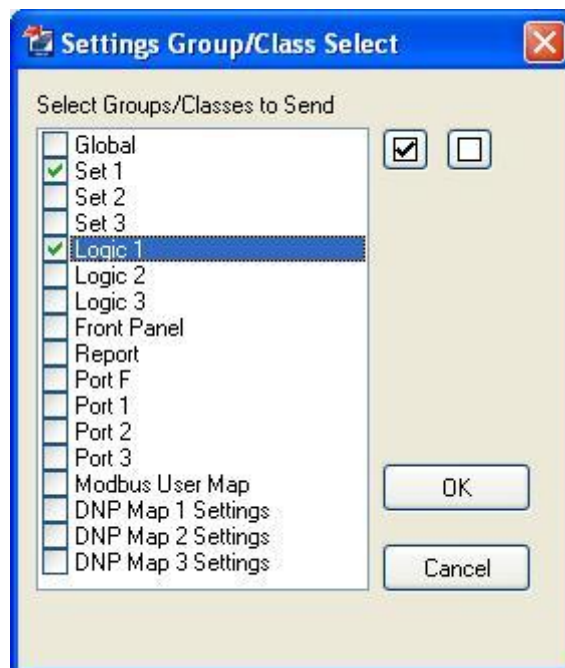


Figure 14

4. Quick software adjustments

4.1 Opening the Quick

Click on the “Conprove Test Center” icon.

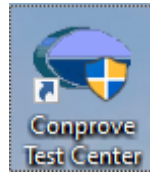


Figure 15

Click on the Quick software icon.

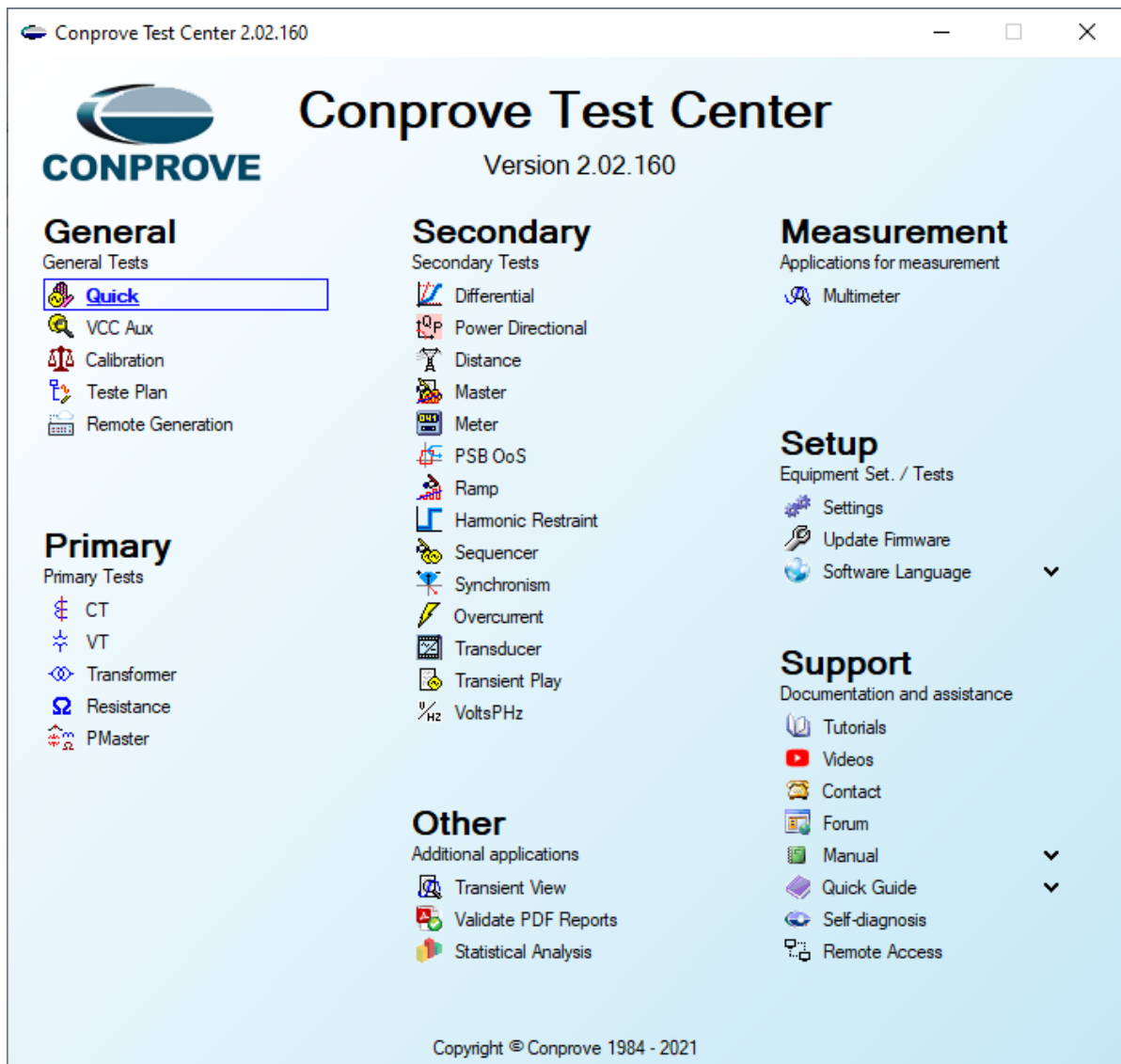


Figure 16

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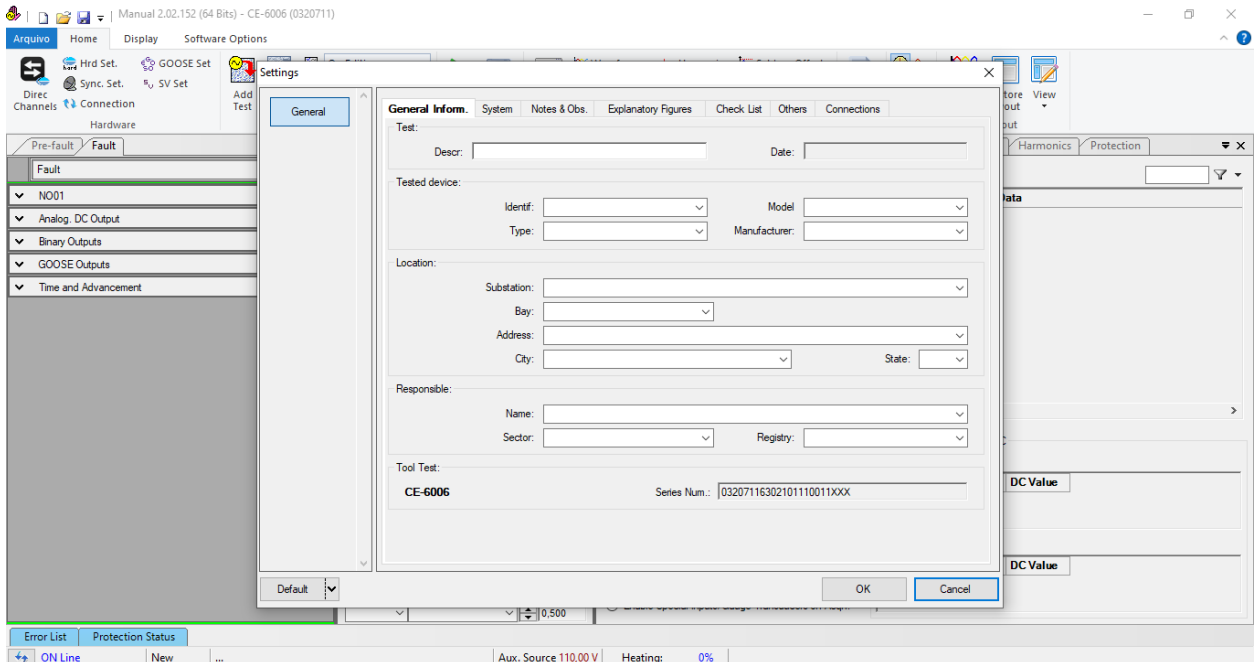


Figure 17

4.2 Configuring the Settings

When opening the software the “Settings” screen will open automatically (provided that the option “Open Settings when Start” found in the “Software Options” menu is selected). Otherwise, click directly on the “Settings” icon.

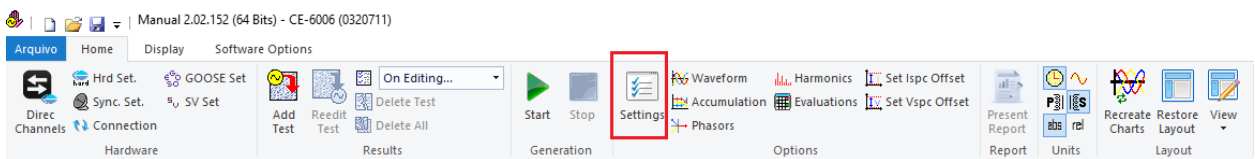


Figure 18

Inside the “Settings” screen, fill in the “General Inform.” with details of the tested device, installation location and the person responsible. This makes reporting easier, as this tab will be the first to be shown.

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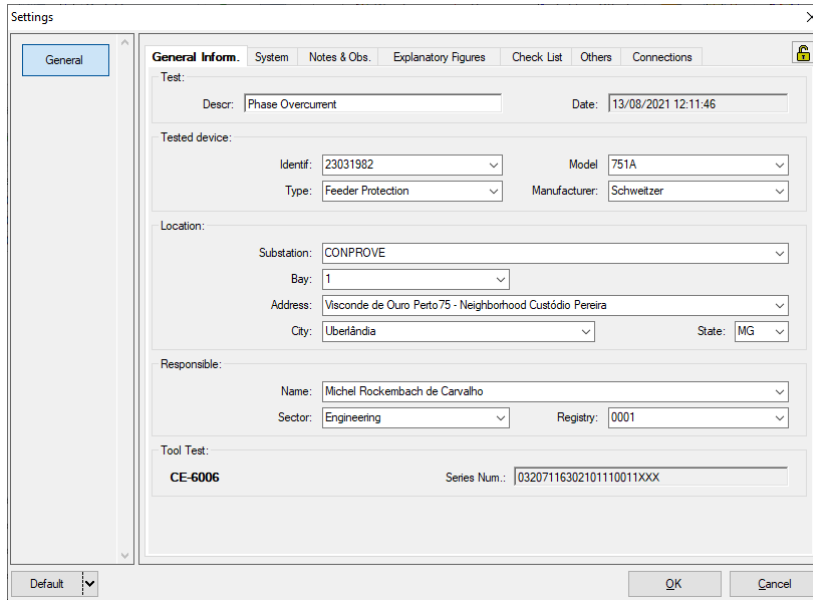
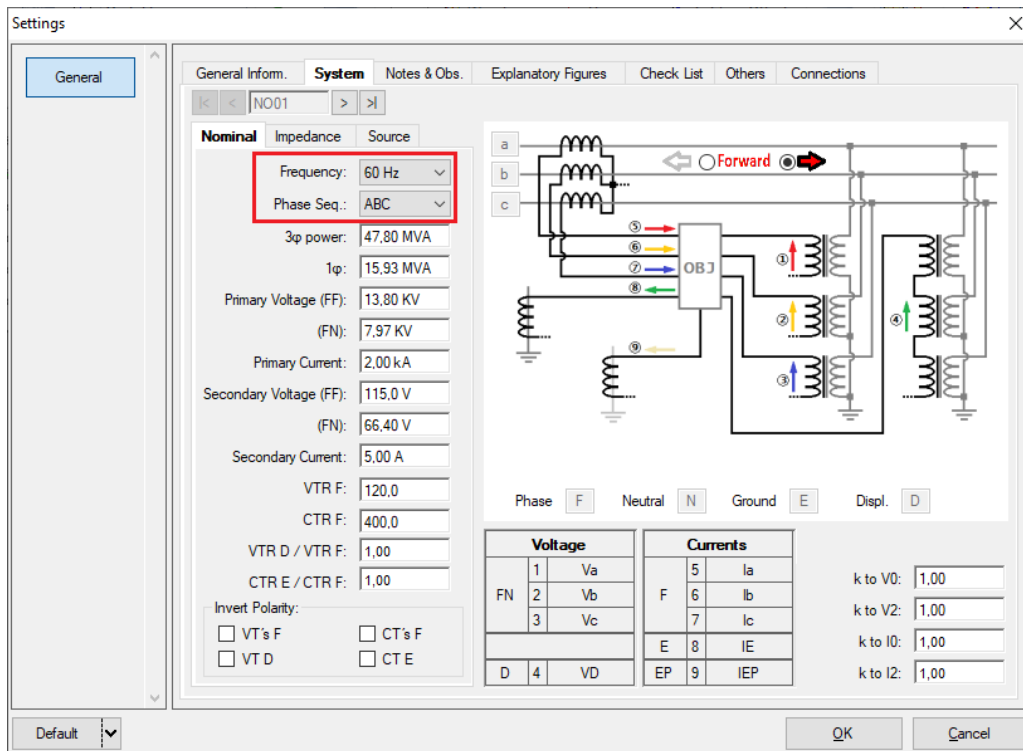


Figure 19

4.3 System

In the following screen, within the Nominal sub tab, the frequency values, phase sequence, primary and secondary voltages, primary and secondary currents, transformation ratios of VTs and CTs are configured. There are also two sub-tabs “Impedance” and “Source” whose data are not relevant for this test.



Voltage		Currents		
1	Va	5	Ia	k to V0: 1,00
2	Vb	6	Ib	k to V2: 1,00
3	Vc	7	Ic	k to I0: 1,00
		8	IE	k to I2: 1,00
D	VD	9	IEP	

Figure 20

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There are other tabs where the user can enter “Notes & Obs., Explanatory Figures,” can create a “Check List” of the procedures for carrying out the test and even create a diagram with all the schematic of the connections between the test set and the test equipment.

5. Channel Targeting and Hardware Configurations

Click on the icon illustrated below.

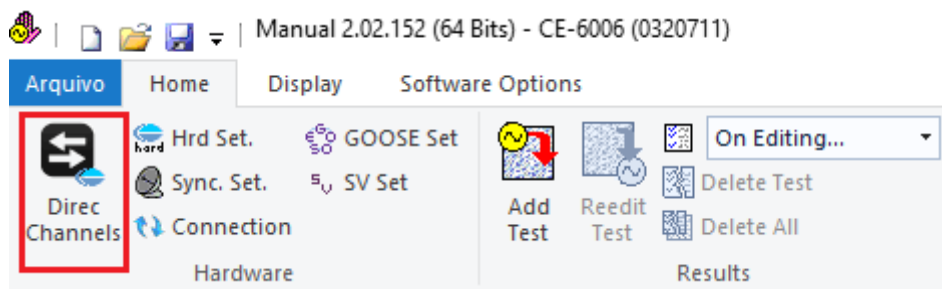


Figure 21

Then click on the highlighted icon to configure the hardware.

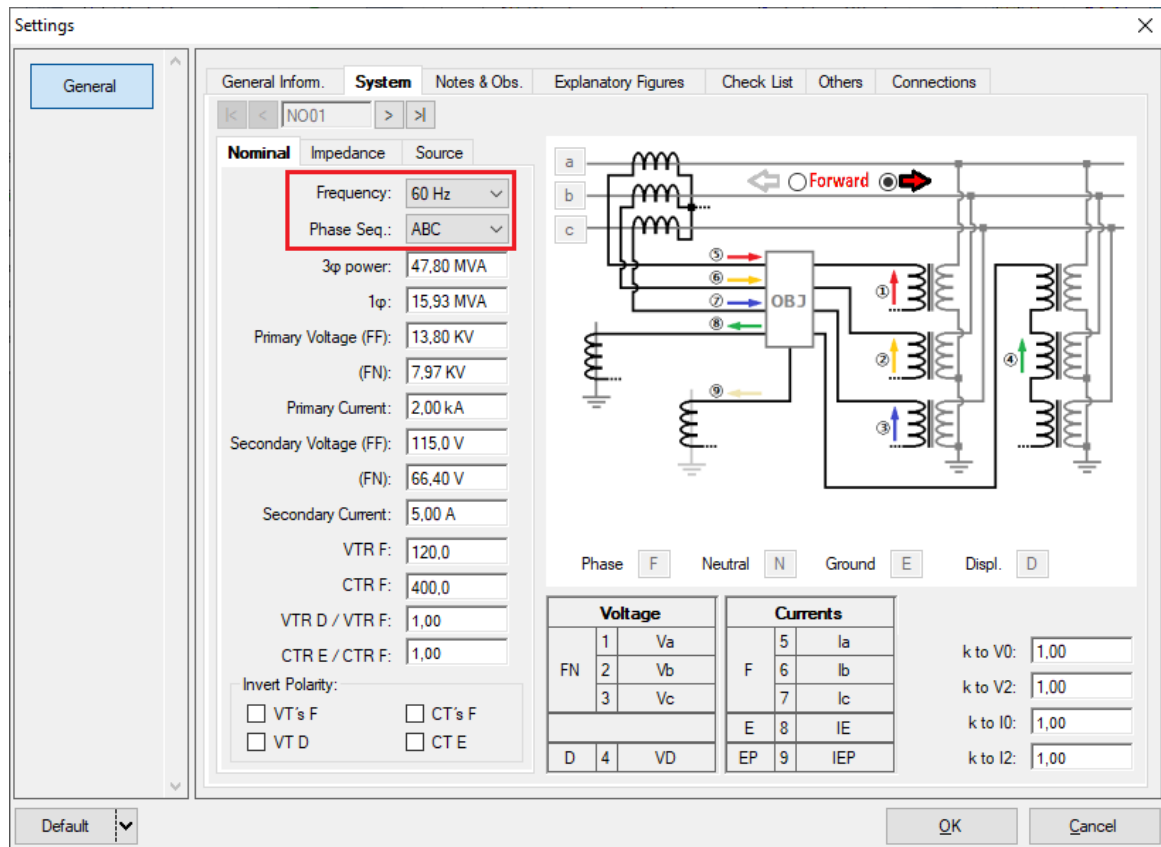


Figure 22

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Choose the channel configuration; adjust the auxiliary source and the stopping method of binary inputs. To finish click on “OK”.

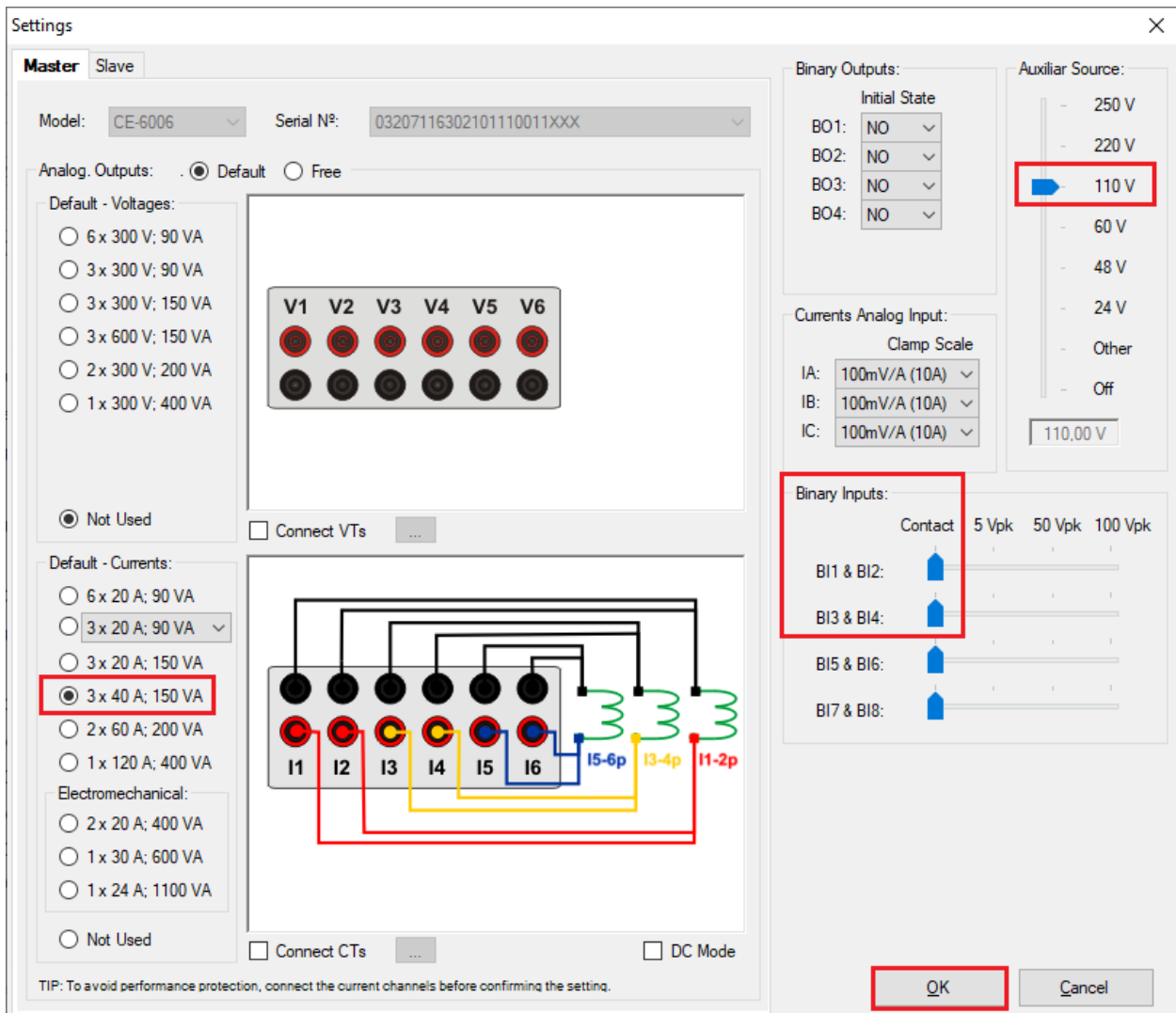


Figure 23

On the next screen choose “Basic” and on the next window (didn’t shown) choose “YES”, finally click on “Confirm”.



Figure 24

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6. Test structure for the 50/51 function

6.1 Main Screen

First, click on the tab “Protection > Current x time > Overcurrent” so that the data adjusted in the relay are configured in the software. Next, near to the current “I” choose a node as a reference, in this case “AO_I01”. Only after choosing the node the fields for adjusting the 50/51 functions become active.

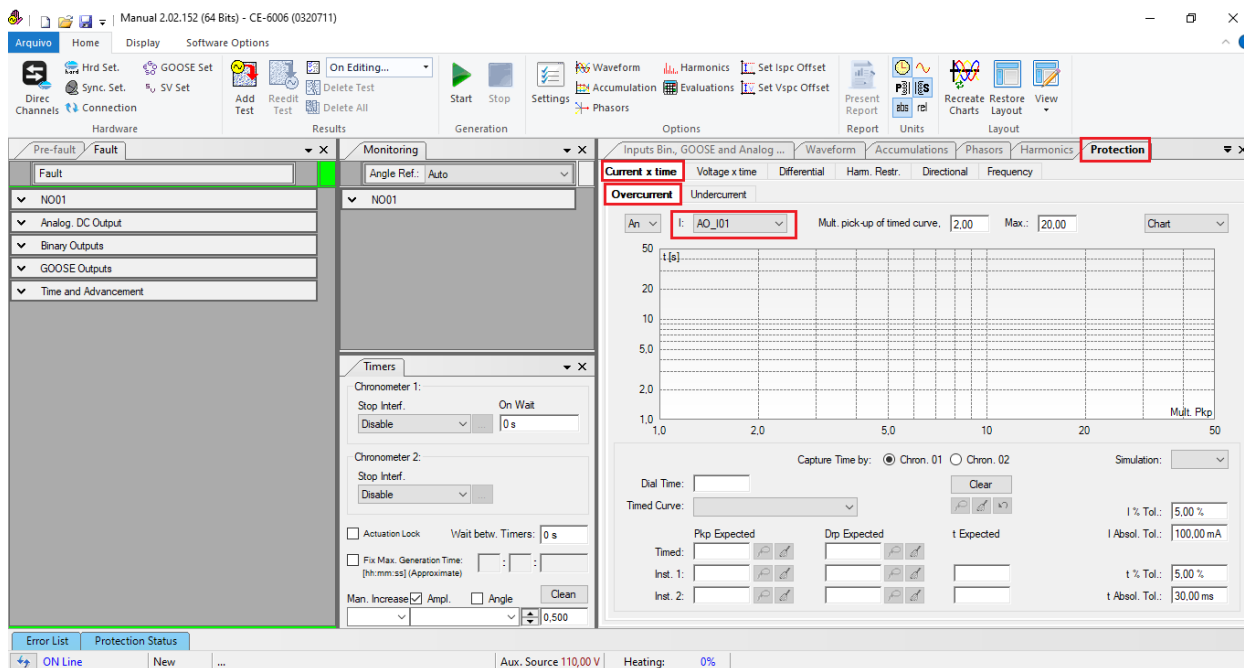


Figure 25

6.2 Overcurrent Screen

For the time overcurrent function, the following values are set:

Table 2

Dial Time	0,5
Timed Curve	IEC NI
Timed (Pkp Expected)	2,5

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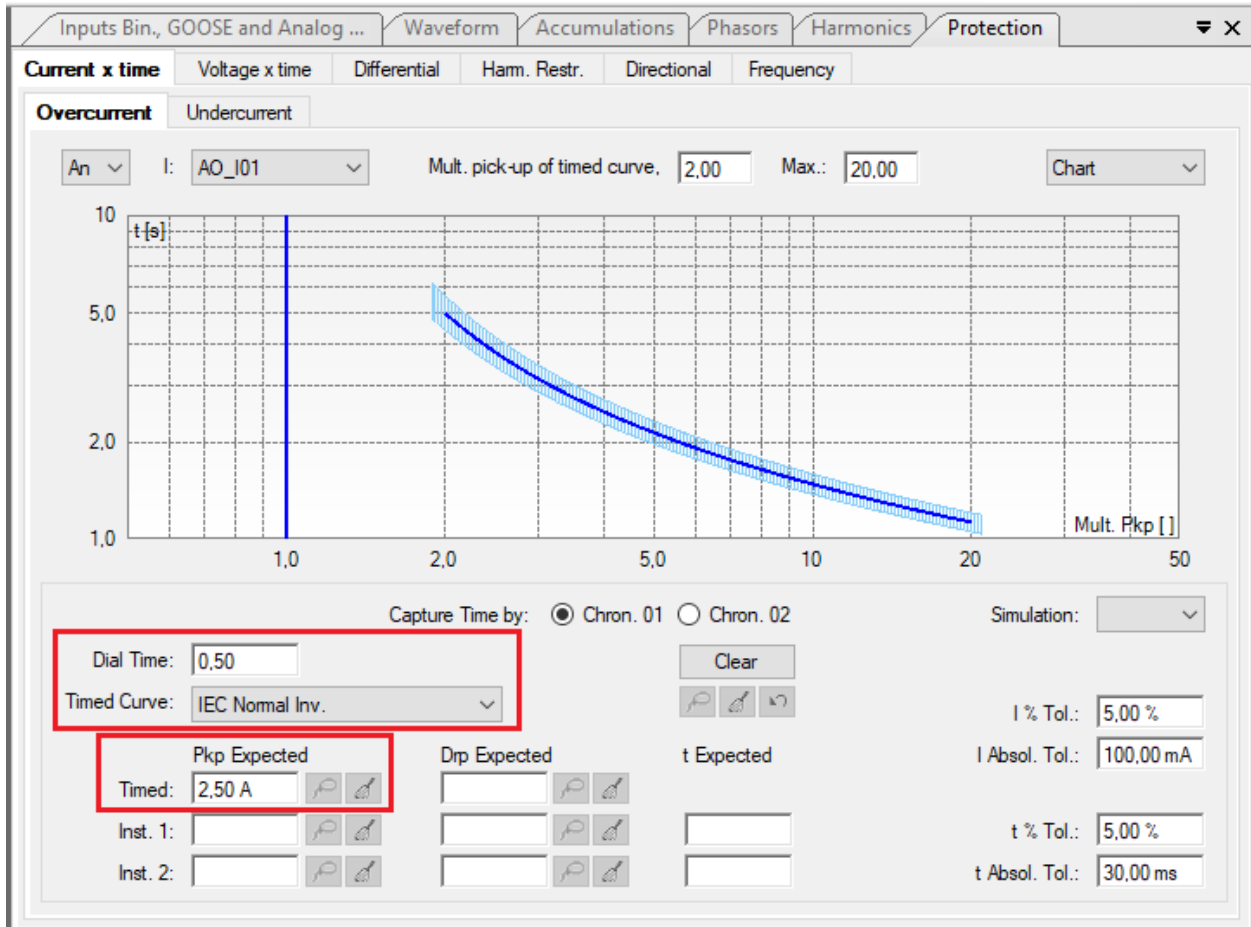


Figure 26

The next adjustment is to enter instantaneous values 1 and 2.

Table 3

	Pkp Expected (A)	T Expected
Inst.1	25,0	300ms
Inst. 2	37,5	0ms

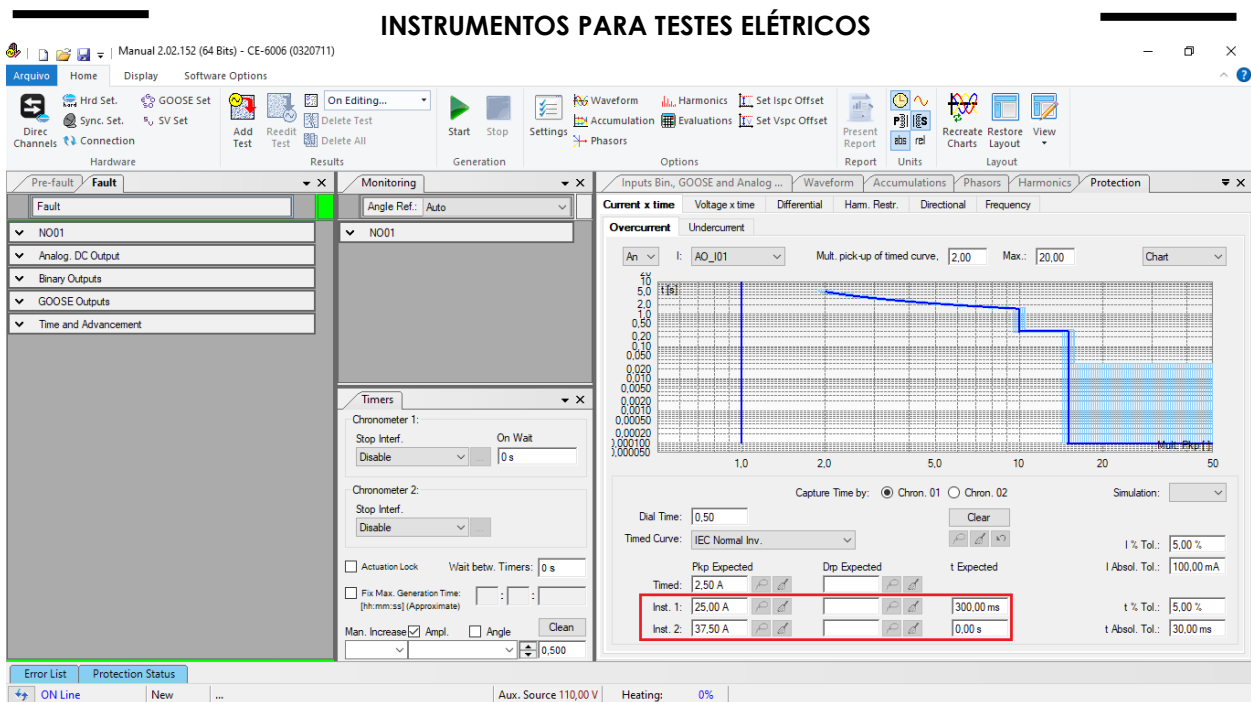


Figure 27

In the “Simulation” field, the fault type, in this case ABC (three-phase) is adjusted, in addition to adjusting the current and time tolerances both relative and absolute. The data shown below are taken from Appendix A.

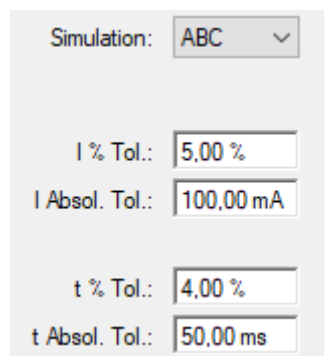


Figure 28

6.3 Timed element pick-up test

For the pick-up test, a ramp is used to increase the current value. For this, choose the tab “N01” the option “Ramp” and click on the highlighted icon.

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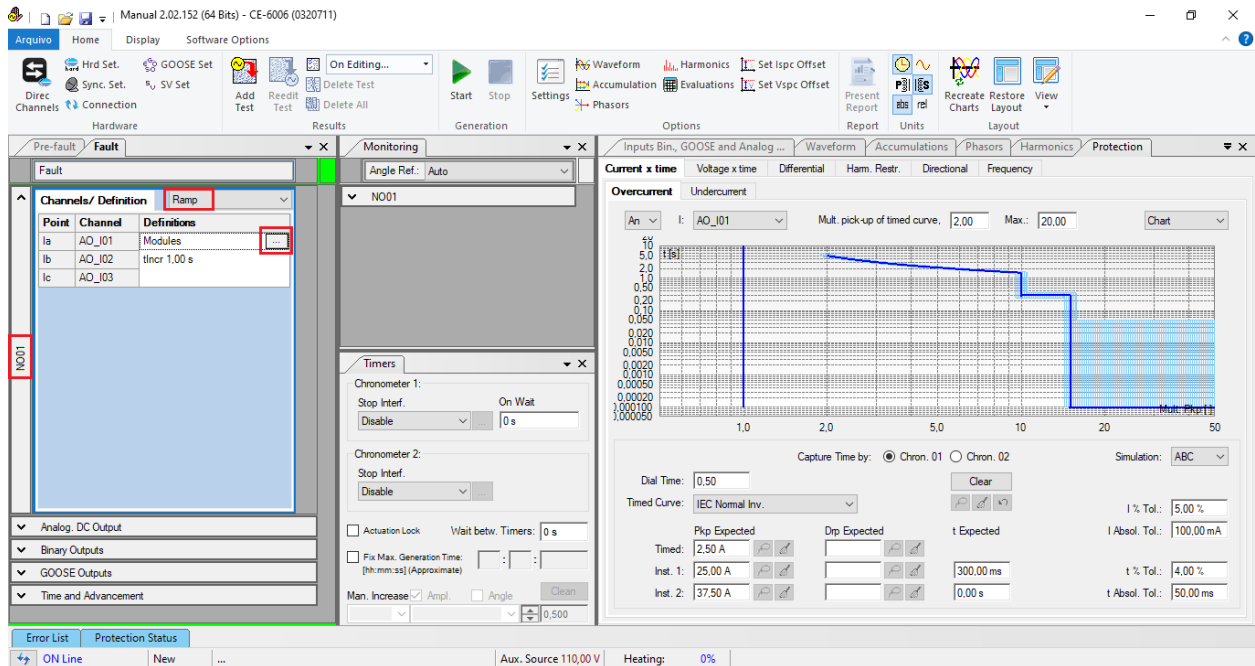


Figure 29

For the first channel set the value of 2,40A, then right click and choose the following options to configure the currents as balanced three-phase with positive rotation.

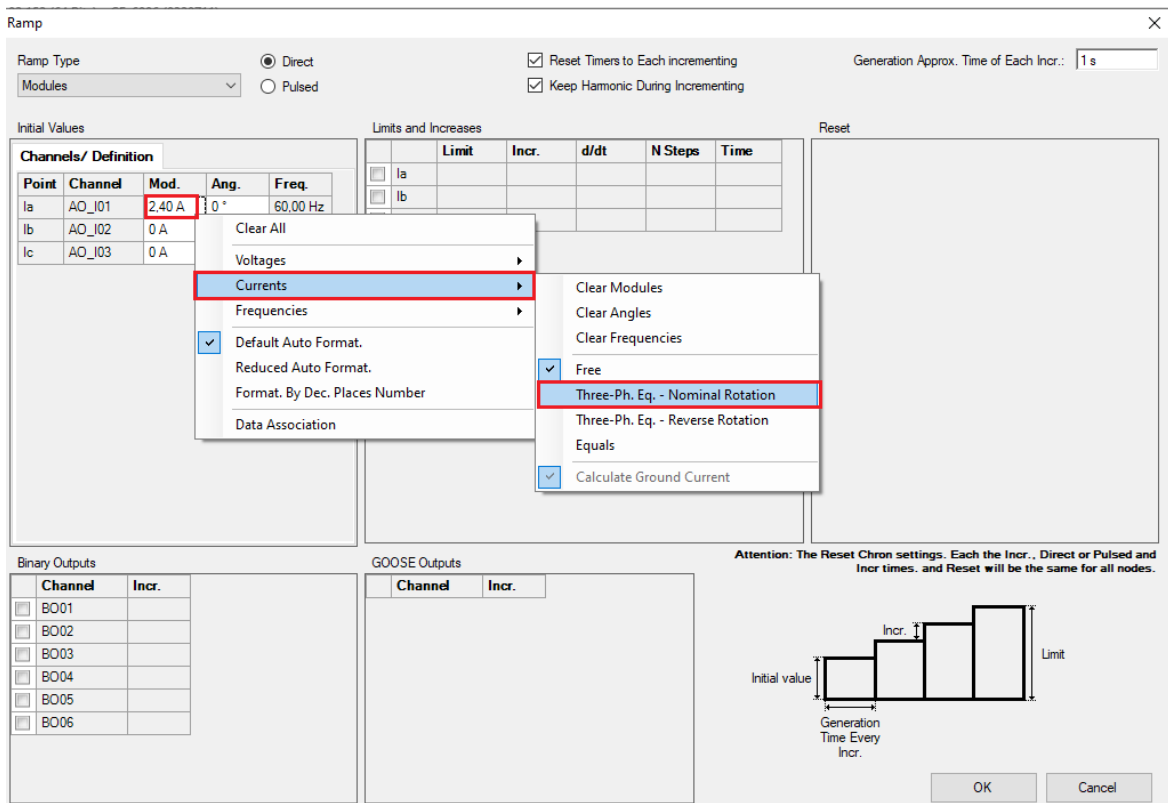
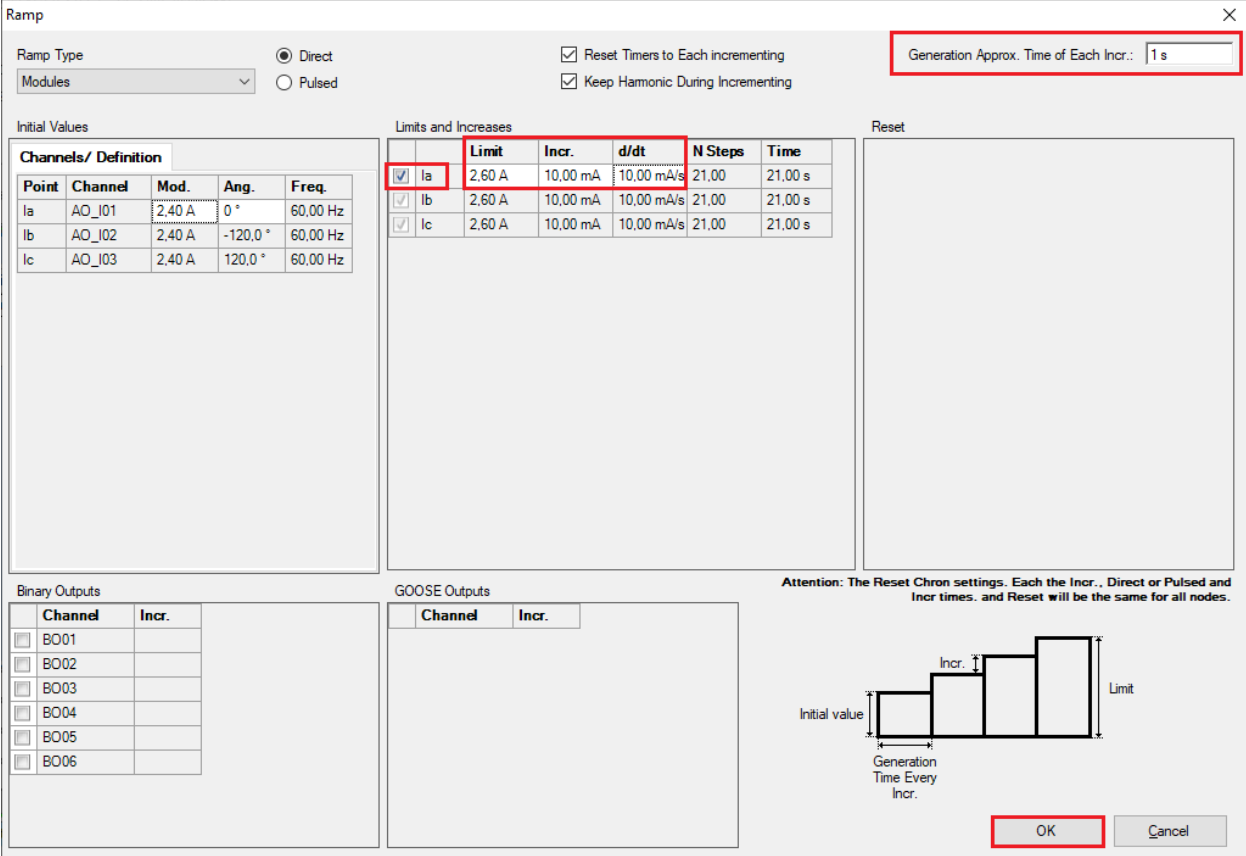


Figure 30

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Select channel “Ia” and adjust the following threshold and increment values.



Initial Values

Point	Channel	Mod.	Ang.	Freq.
Ia	AO_I01	2,40 A	0 °	60,00 Hz
Ib	AO_I02	2,40 A	-120,0 °	60,00 Hz
Ic	AO_I03	2,40 A	120,0 °	60,00 Hz

Limits and Increases

	Limit	Incr.	d/dt	N Steps	Time
<input checked="" type="checkbox"/> Ia	2,60 A	10,00 mA	10,00 mA/s	21,00	21,00 s
<input checked="" type="checkbox"/> Ib	2,60 A	10,00 mA	10,00 mA/s	21,00	21,00 s
<input checked="" type="checkbox"/> Ic	2,60 A	10,00 mA	10,00 mA/s	21,00	21,00 s

Binary Outputs

Channel	Incr.
<input type="checkbox"/> BO01	
<input type="checkbox"/> BO02	
<input type="checkbox"/> BO03	
<input type="checkbox"/> BO04	
<input type="checkbox"/> BO05	
<input type="checkbox"/> BO06	

GOOSE Outputs

Channel	Incr.

Attention: The Reset Chron settings. Each the Incr., Direct or Pulsed and Incr times, and Reset will be the same for all nodes.

Initial value
Incr.
Limit
Generation Time Every Incr.

OK Cancel

Figure 31

The next step is to choose the stop interface which in this case is BI04. Start the generation by clicking on the icon below or using the shortcut “Alt + G”.

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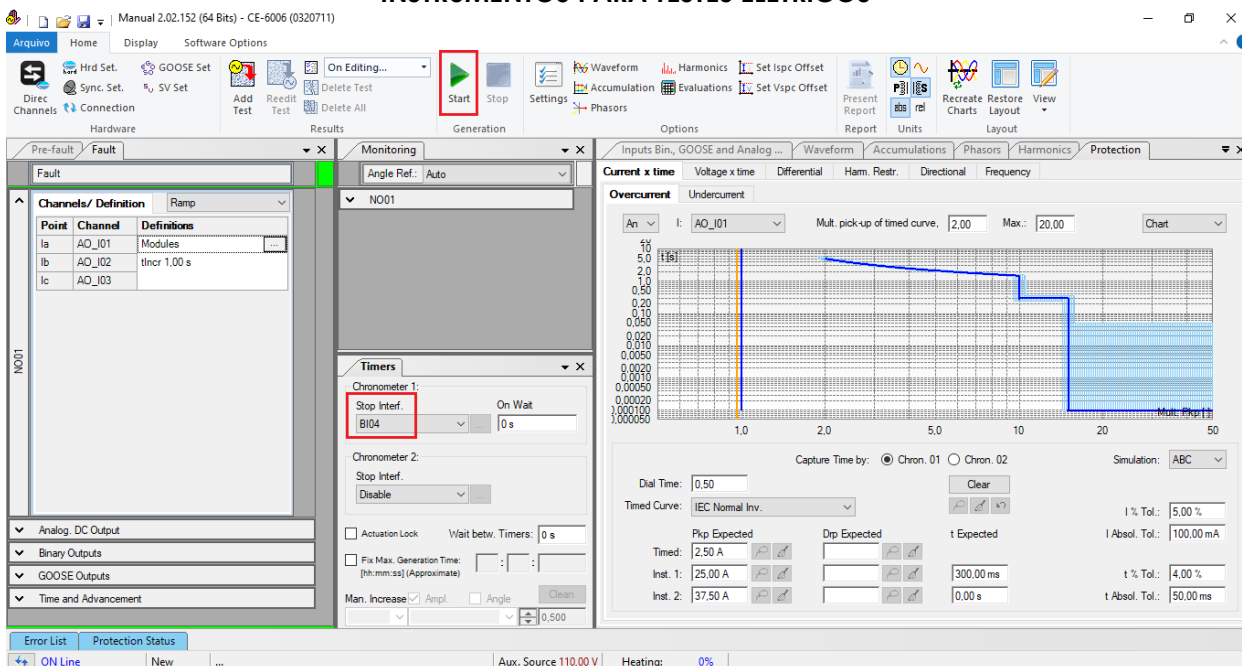


Figure 32

To view the values being generated click on “N01” within the “Monitoring” tab. After the performance click on the highlighted icon to capture the tested point.

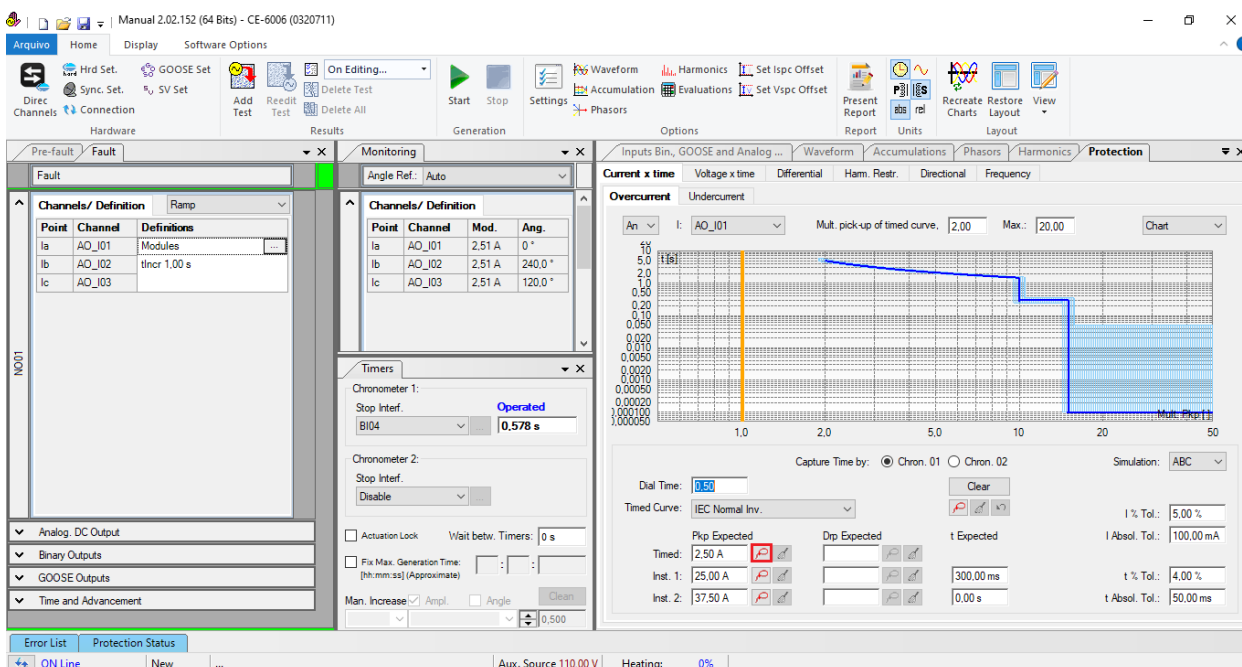


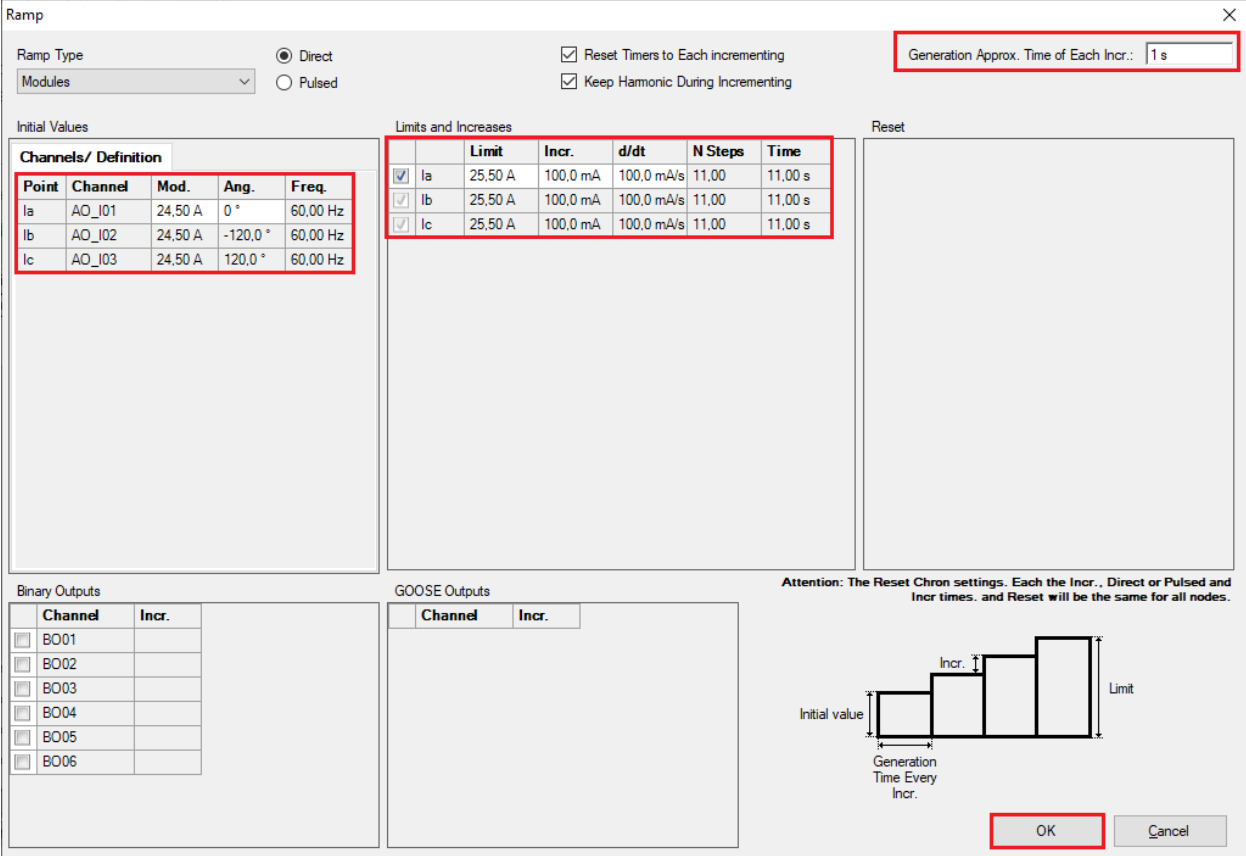
Figure 33

In this case, the pickup found was 2.51A, within tolerance.

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6.4 Instantaneous Element 1 Pick-up Test

Click on the “...” icon and enter an initial value of 24,50A, limit value of 25,50A and the increment as 100.0mA.



Initial Values

Point	Channel	Mod.	Ang.	Freq.
la	AO_I01	24,50 A	0 °	60,00 Hz
lb	AO_I02	24,50 A	-120,0 °	60,00 Hz
lc	AO_I03	24,50 A	120,0 °	60,00 Hz

Limits and Increases

	Limit	Incr.	d/dt	N Steps	Time
<input checked="" type="checkbox"/> la	25,50 A	100,0 mA	100,0 mA/s	11,00	11,00 s
<input checked="" type="checkbox"/> lb	25,50 A	100,0 mA	100,0 mA/s	11,00	11,00 s
<input checked="" type="checkbox"/> lc	25,50 A	100,0 mA	100,0 mA/s	11,00	11,00 s

Binary Outputs

Channel	Incr.
<input type="checkbox"/> BO01	
<input type="checkbox"/> BO02	
<input type="checkbox"/> BO03	
<input type="checkbox"/> BO04	
<input type="checkbox"/> BO05	
<input type="checkbox"/> BO06	

GOOSE Outputs

Channel	Incr.

Attention: The Reset Chron settings. Each the Incr., Direct or Pulsed and Incr times, and Reset will be the same for all nodes.

Initial value
Incr.
Limit
Generation Time Every Incr.

OK Cancel

Figure 34

The next step is to choose the stop interface which in this case is “BI01”. Start the generation by clicking on the icon below or through the shortcut “Alt + G”.

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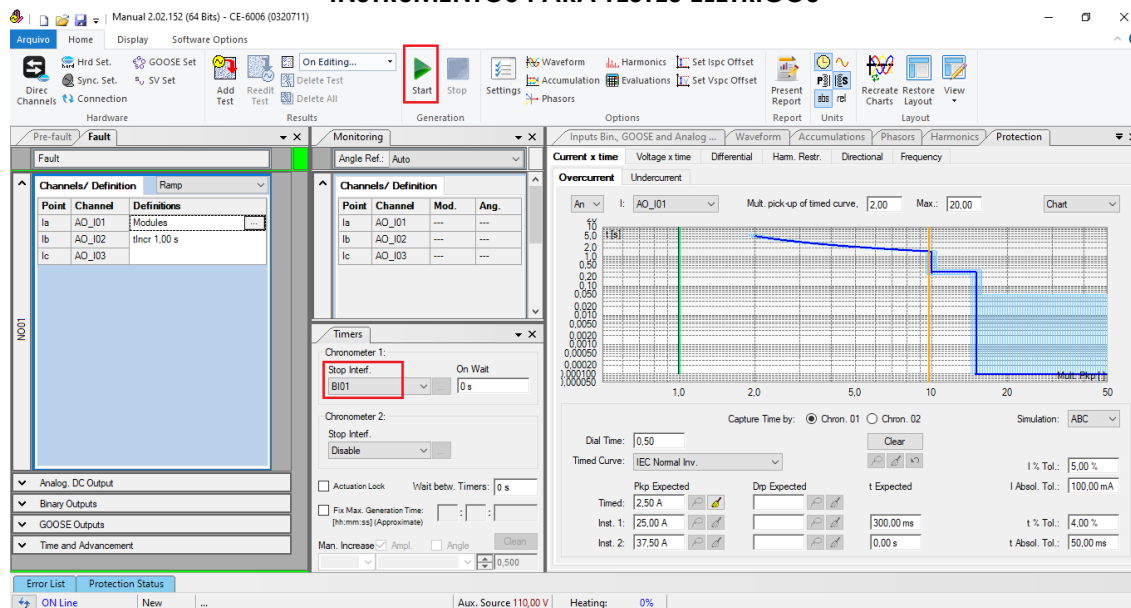


Figure 35

The value of the pick-up was found to be 25,1A being within the range of values provided by the manufacturer.

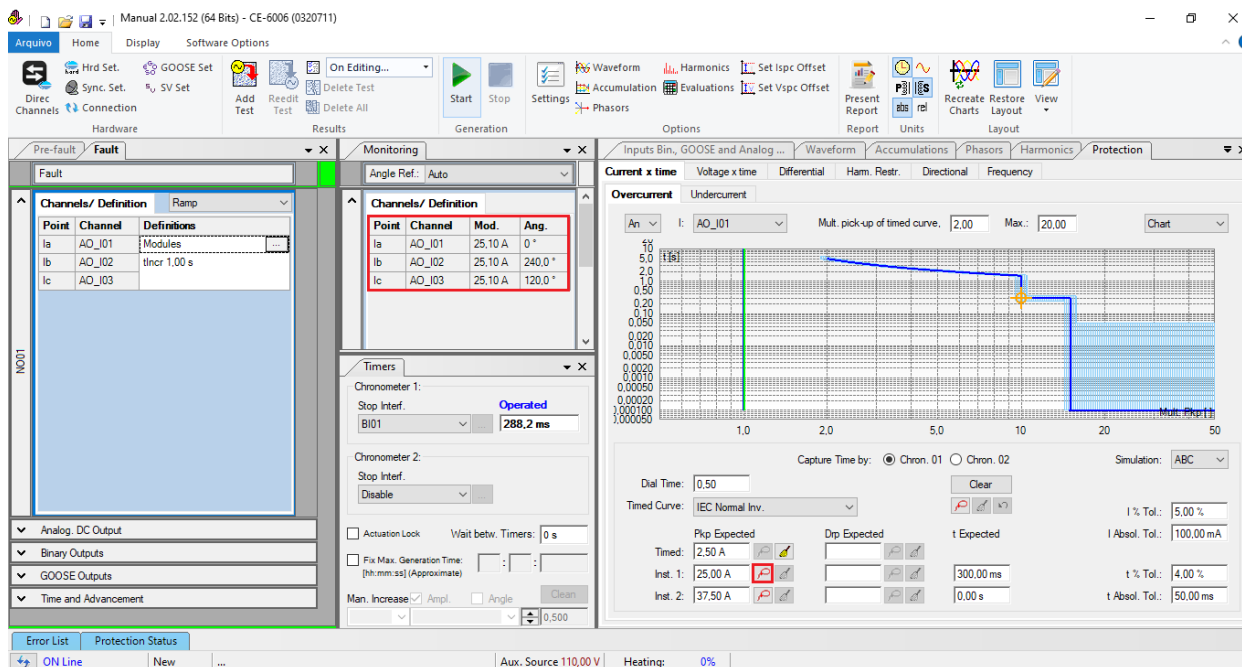


Figure 36

6.5 Instantaneous Element 2 Pick-up Test

Insert a ramp with an initial value of 37.00A, limit value of 38.00A with an increment value of 100.0mA and use Binary Input 2 (BI02) as the stop interface. After the

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performance capture the point by clicking on the highlighted icon. The figure below shows the point already captured.

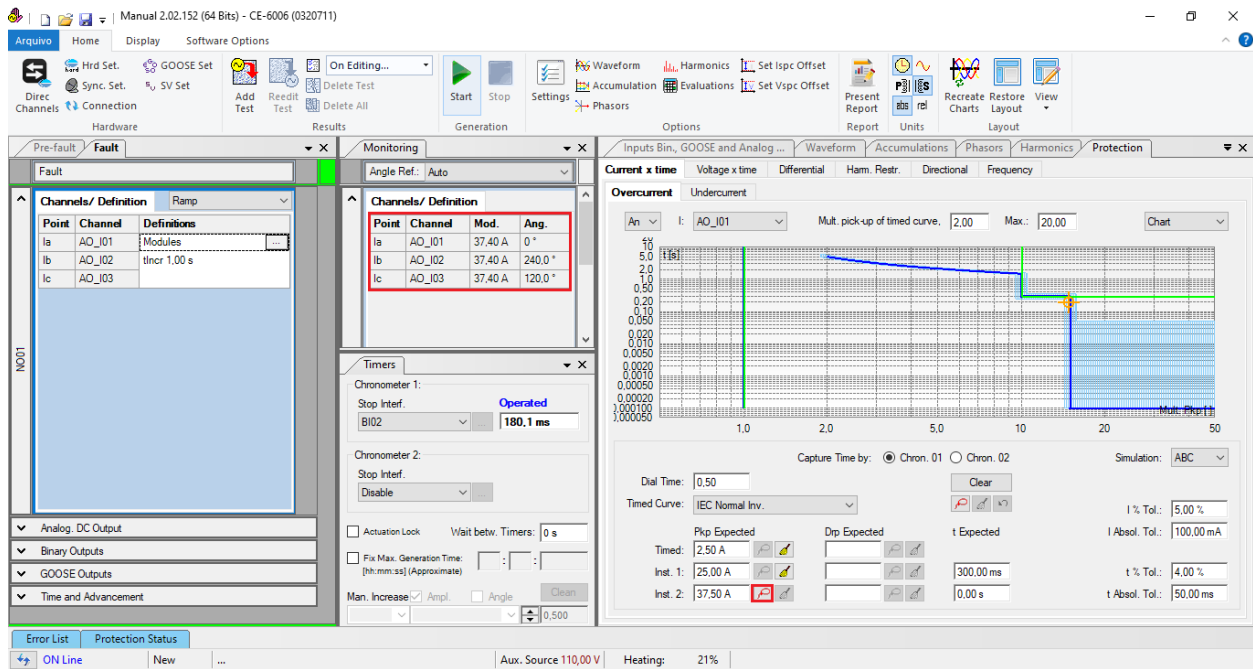


Figure 37

The value of the pick-up was found to be 37,4A being within the range of values provided by the manufacturer.

6.6 Curve Points Test

In this case, multiples of the timed element pickup is chosen as current values to be tested. The first point tested was multiple 2 located at the beginning of the curve. As the pickup is 2,5A the current value of the first point to be tested is 5,0A. In this case, you must remove the ramp and choose the direct option. Change input binary to “BI03” wait for actuation and capture point by clicking highlighted icon.

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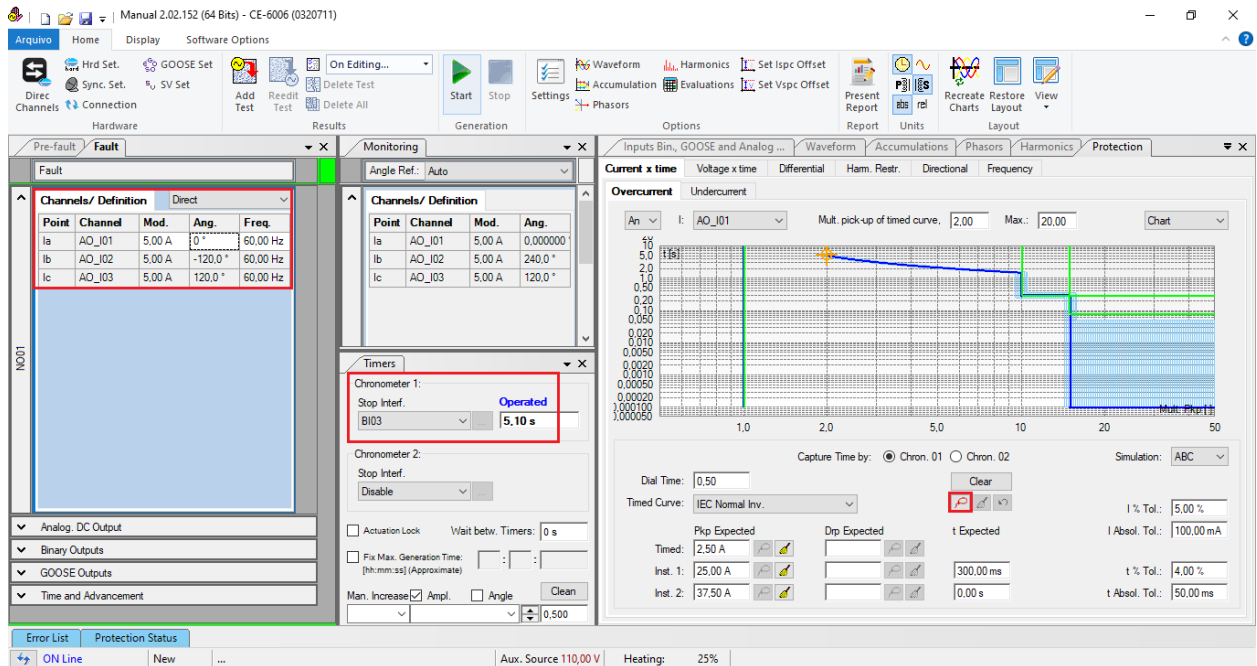


Figure 38

Repeat the process and choose other multiples, for example 3 and 5. The user can to test as many points as he deems necessary. However the 3 points are enough to prove the time dial, the norm and the curve type.

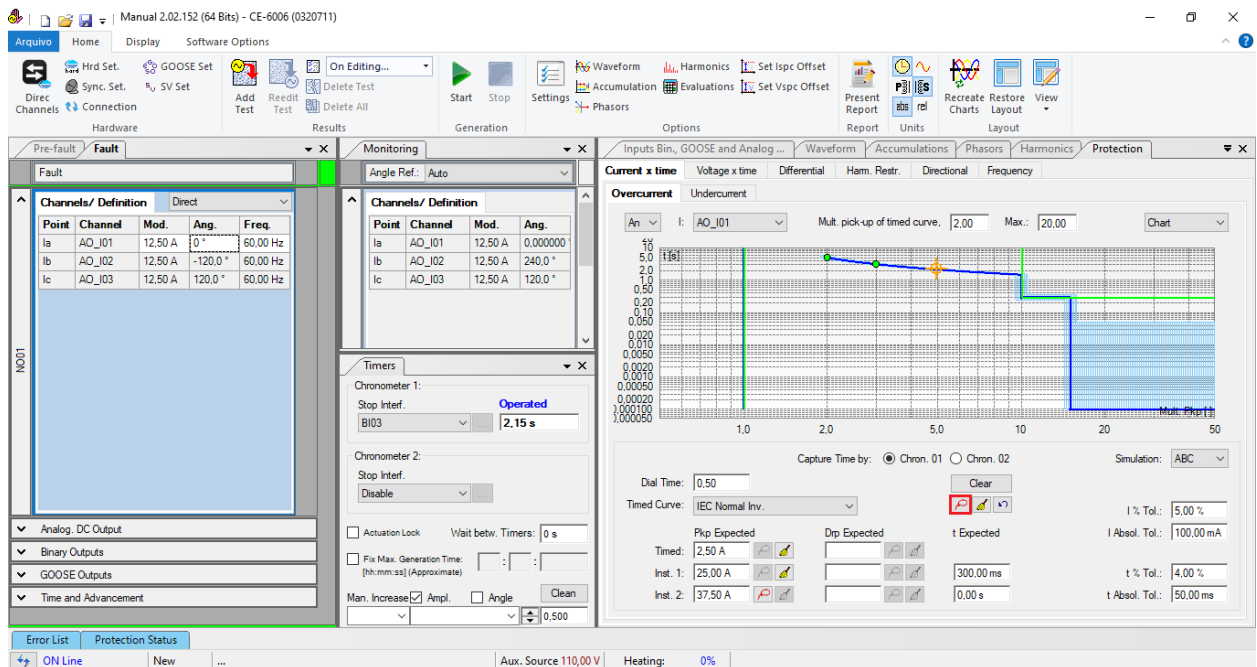


Figure 39

The time found for each point is within the tolerance provided by the manufacturer.

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6.7 Instantaneous 1 Points Test

To check the operating time of element 1, choose BI01 and test points with current values above the pick-up value. The following figure shows the 26,0A value already captured and the 36,0A value not yet captured.

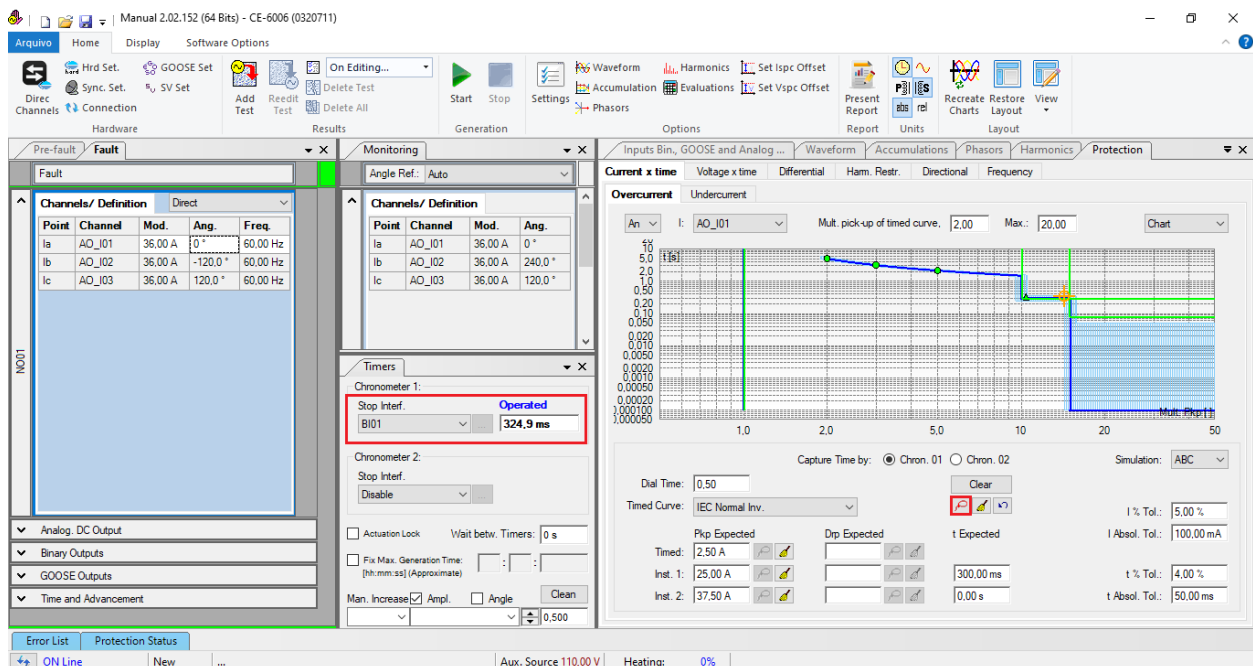


Figure 40

It is verified that the operating times are within the tolerance.

6.8 Instantaneous 2 Points Test

To check the operating time of element 2, choose BI02 and test points with current values above the pick-up value. The following figure shows the 38,0A value already captured and the 40,0A value not yet captured.

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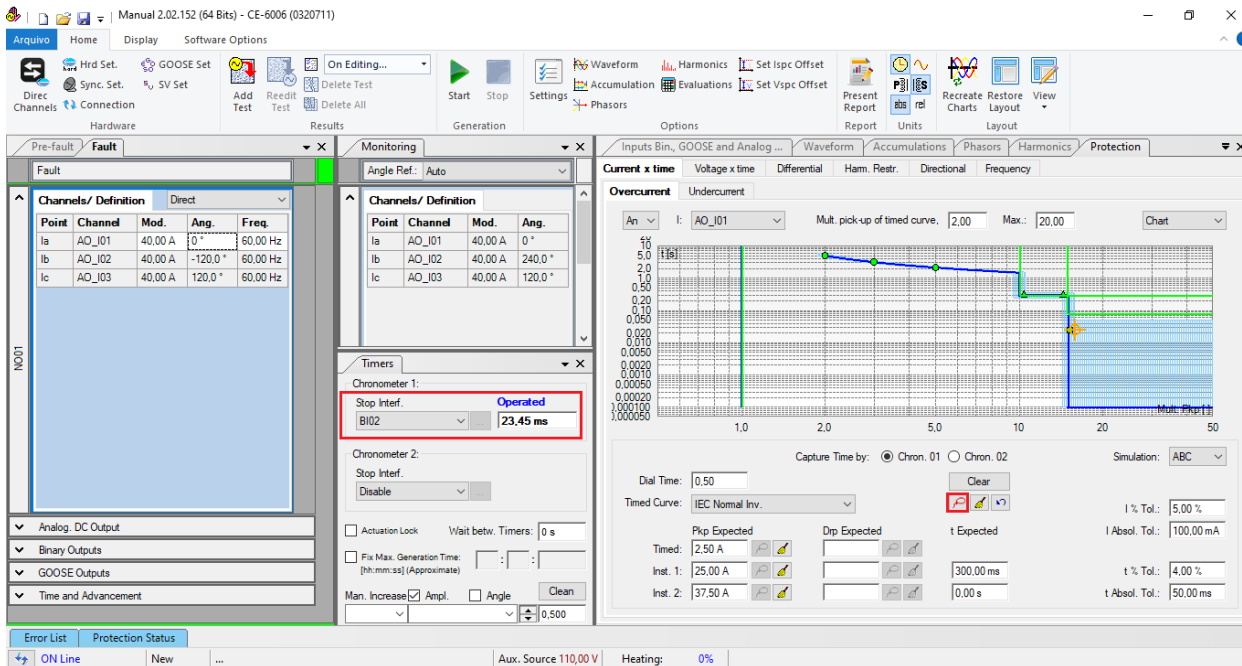


Figure 41

It is verified that the operating times are within the tolerance. By choosing the option "Table" and in the tab "Ixt" you will find the current and time values captured, the allowed time range and the final approval of the tested points.

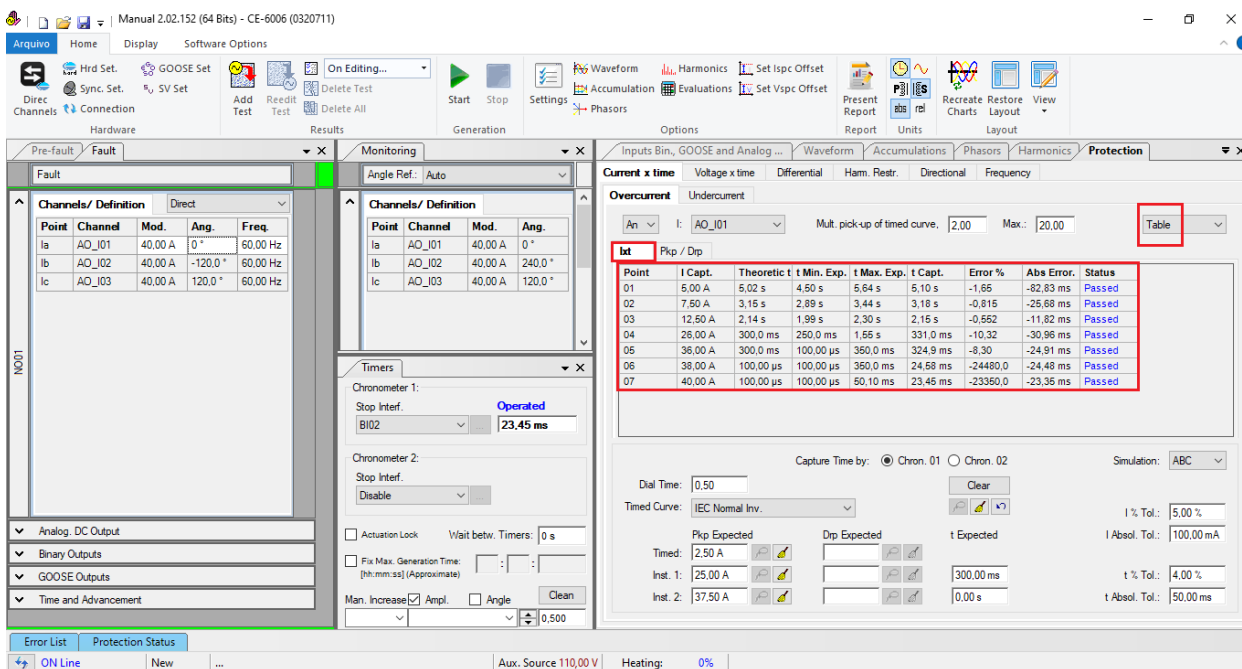


Figure 42

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By clicking on the “*Pkp/Drp*” tab, the expected, captured values, relative and absolute errors for the pick-up tests are observed, as well as the final approval of the tested points.

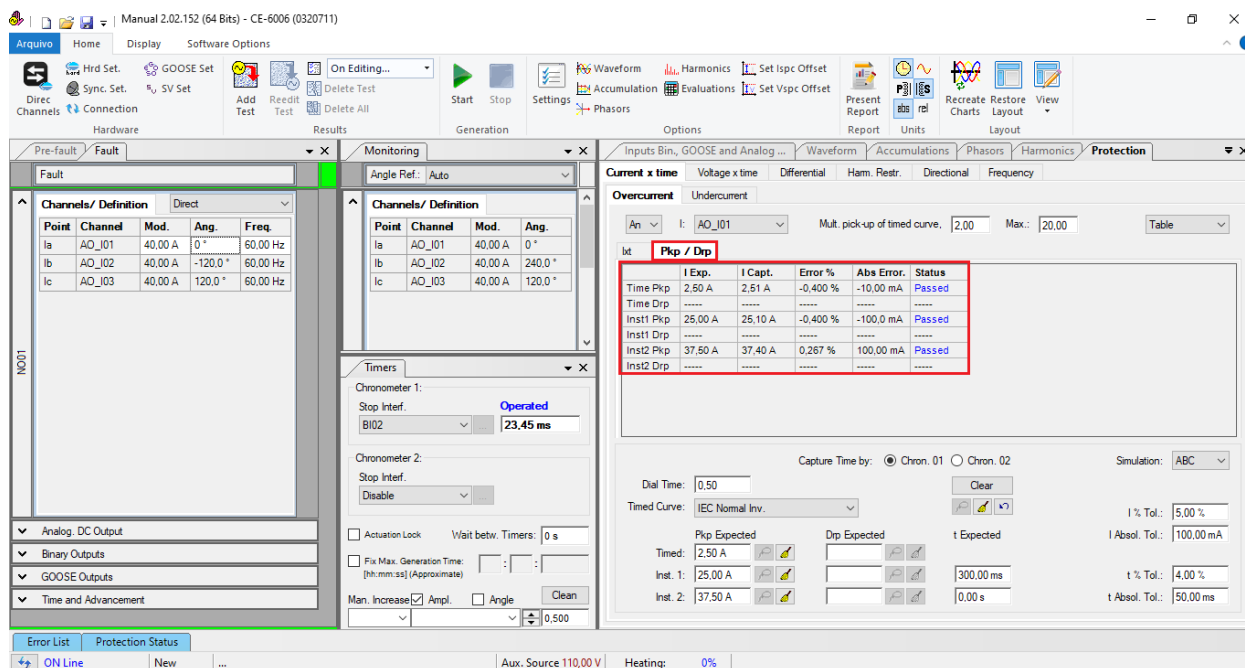


Figure 43

7. Report

At the end of the test, an automatic report can be requested, just click on the icon illustrated below or use the shortcut “*Ctrl + R*”.

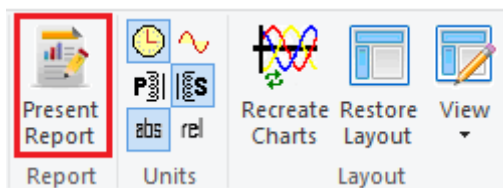


Figure 44

When requesting the report, a screen opens where the user chooses the information that should be shown in the report.

INSTRUMENTOS PARA TESTES ELÉTRICOS

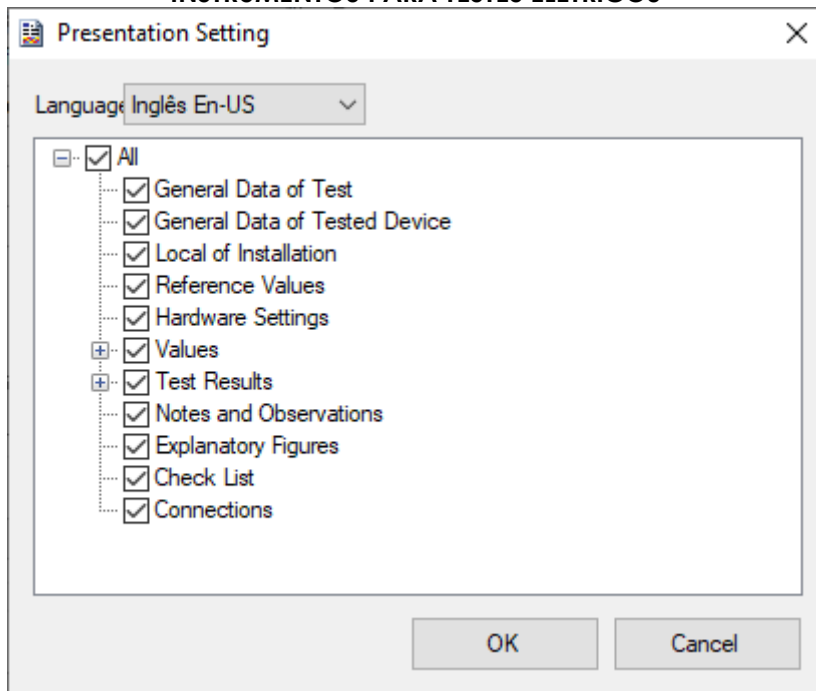


Figure 45

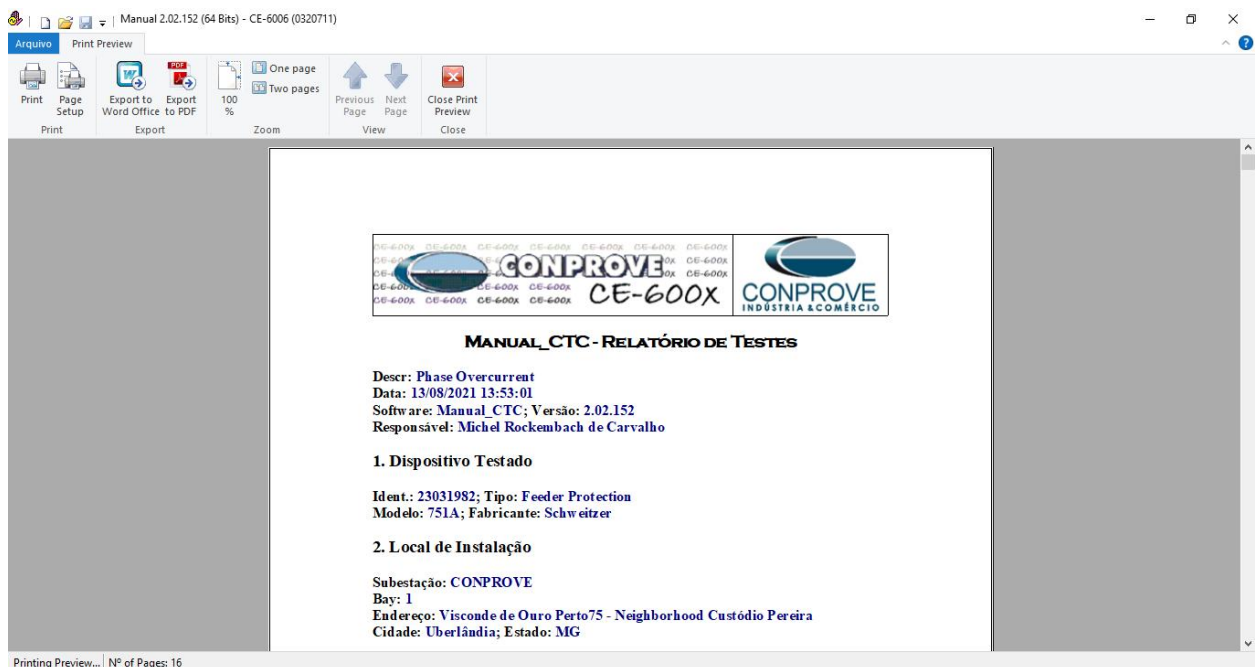


Figure 46

APPENDIX A

A.1 Terminal Designations

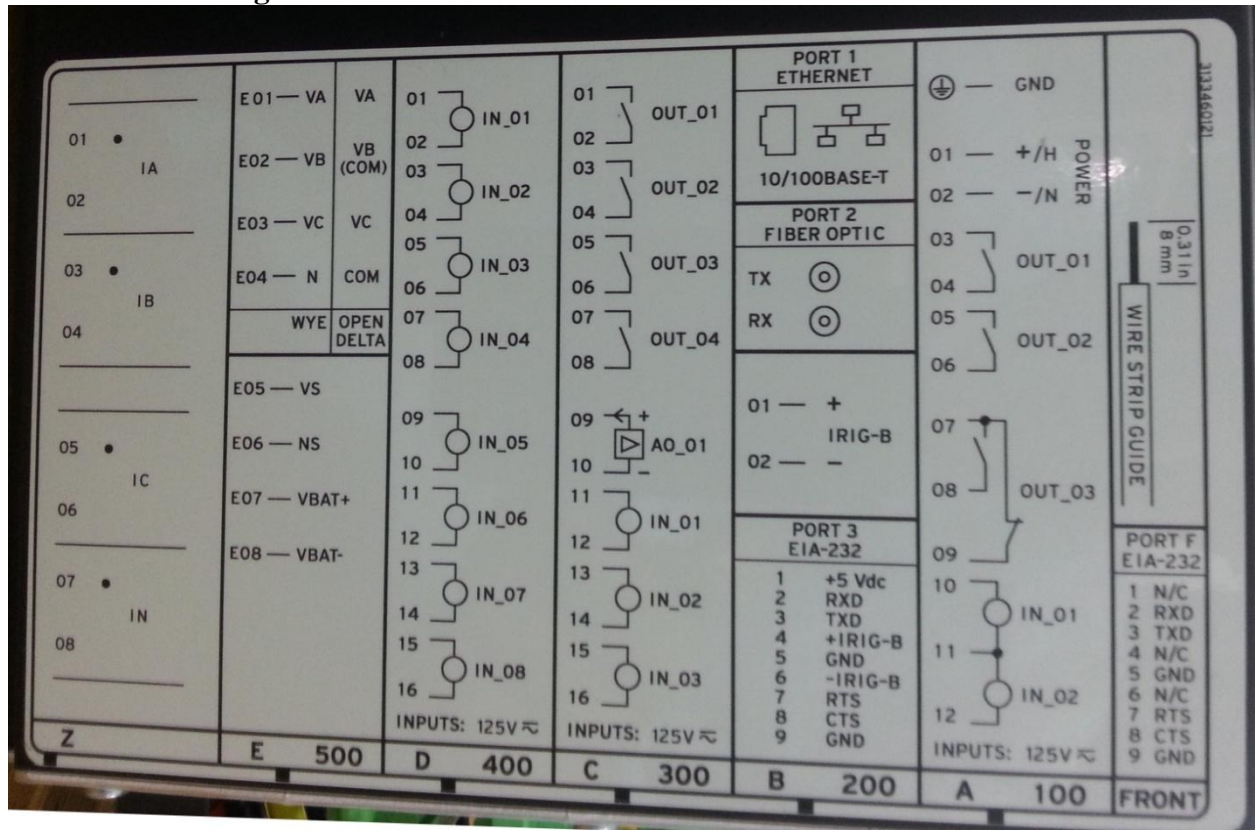


Figure 47

A.2 Technical Data

Instantaneous/Definite-Time Overcurrent (50P, 50G, 50N, 50Q)

Pickup Setting Range, A Secondary

5 A Models:	0.50–100.00 A, 0.01 A steps
1 A Models:	0.10–20.00 A, 0.01 A steps
50 mA Models:	5.0–1000.0 mA, 0.1 mA steps
2.5 mA Models:	0.13–12.50 mA, 0.01 mA steps

(The 50N elements in the 2.5 mA and 50 mA models have a built-in 30 ms security qualifier time delay.)

Accuracy:	$\pm 5\%$ of setting $\pm 0.02 \cdot I_{NOM}$ A secondary (steady-state pickup)
Time Delay:	0.00–5.00 seconds, 0.01 seconds steps
Pickup/Dropout Time:	<1.5 cycles

Inverse-Time Overcurrent (51P, 51G, 51N, 51Q)

Pickup Setting Range, A Secondary:

5 A Models:	0.50–16.00 A, 0.01 A steps
1 A Models:	0.10–3.20 A, 0.01 A steps
50 mA Models:	5.0–160.0 mA, 0.1 mA steps
2.5 mA Models:	0.13–2.00 mA, 0.01 mA steps

Accuracy:	$\pm 5\%$ of setting $\pm 0.02 \cdot I_{NOM}$ A secondary (steady-state pickup)
Time Dial:	
U.S.:	0.50–15.00, 0.01 steps
IEC:	0.05–1.00, 0.01 steps
Accuracy:	± 1.5 cycles, $\pm 4\%$ between 2 and 30 multiples of pickup (within rated range of current)

APPENDIX B

Equivalence of software parameters and the relay under test.

Table 4

Quick Software		SEL 751A Relay	
Parameter	Figure	Parameter	Figure
Dial Time	26	51_TD TOC Time Dial	11
Timed Curve	26	51_C TOC Curve Selection	11
Timed	26	51_P Time Overcurrent Trip Pickup	11
Inst. 1	27	50P1P Maximum Phase Overcurrent Trip Pickup	10
t Expected	27	50P1D Maximum Phase Overcurrent Trip Delay	10
Inst. 2	27	50P2P Maximum Phase Overcurrent Trip Pickup	10
t Expected	27	50P2D Maximum Phase Overcurrent Trip Delay	10